

ISSN 003-68156

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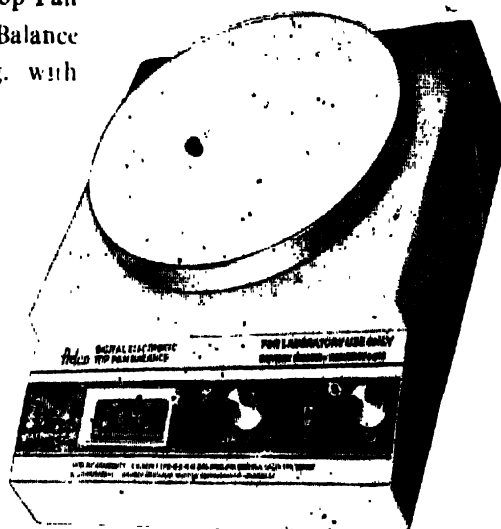
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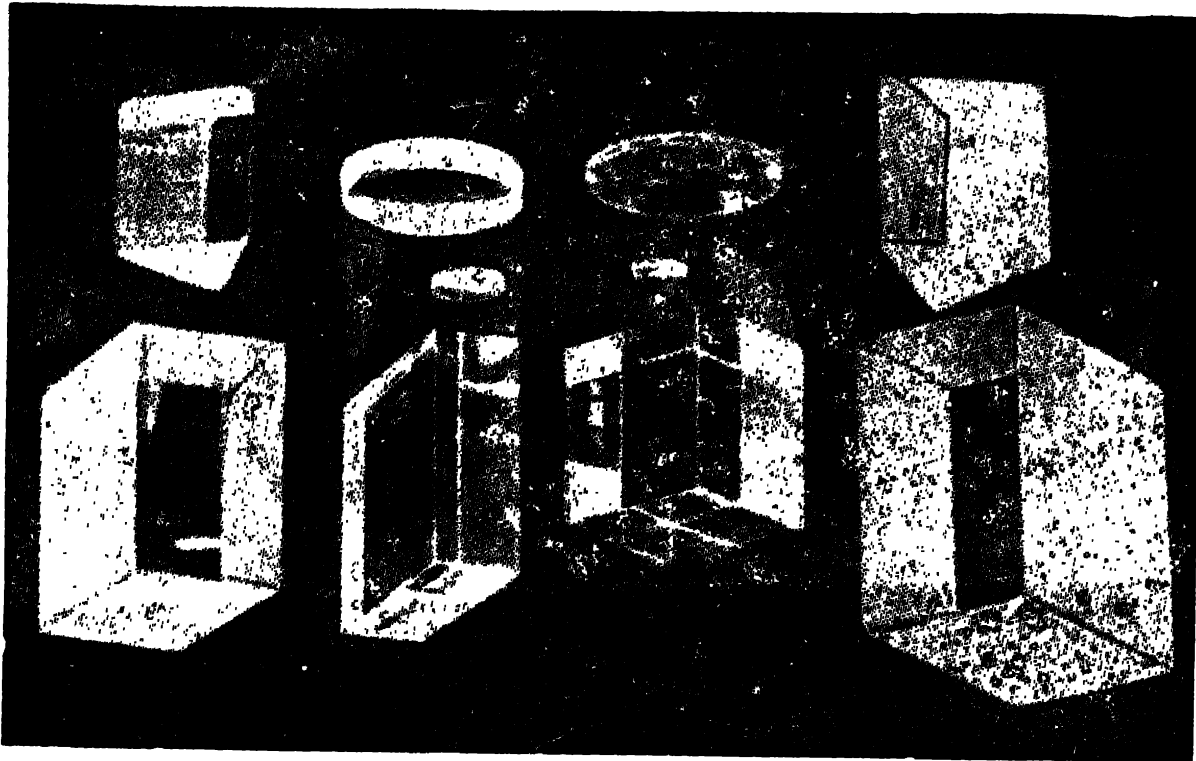
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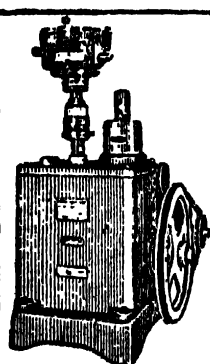
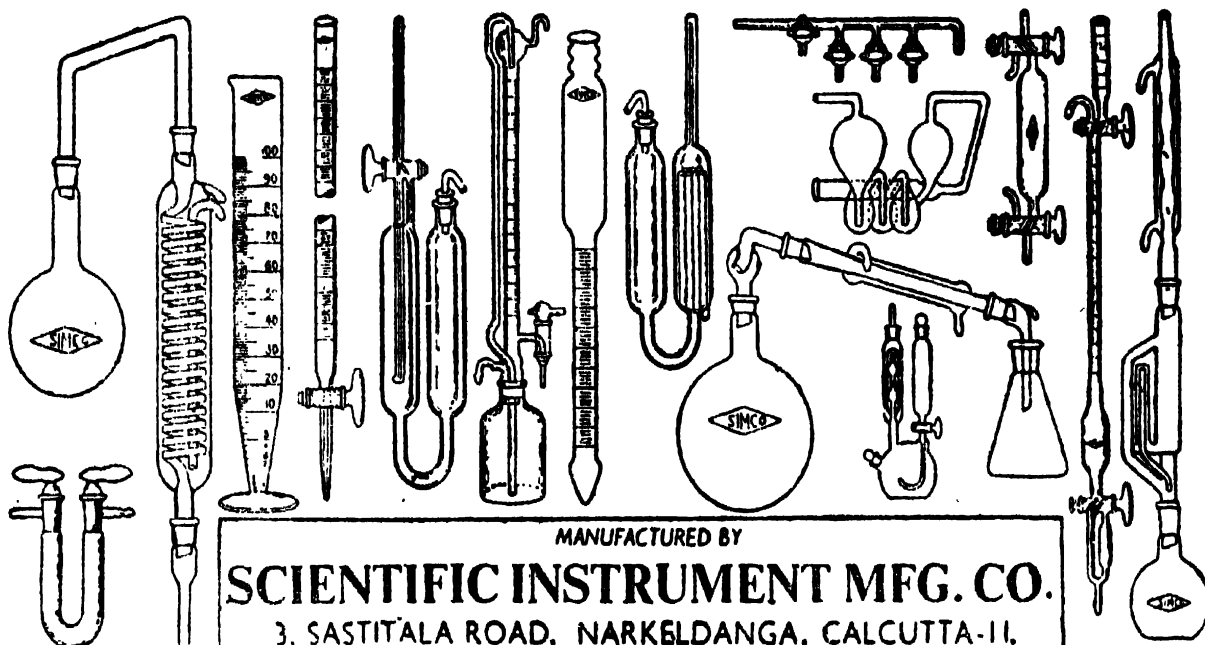
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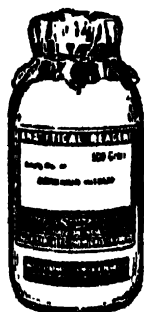
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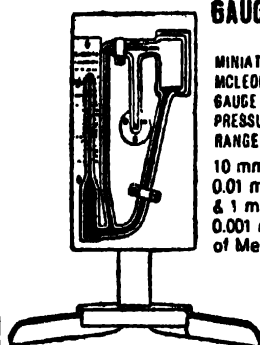


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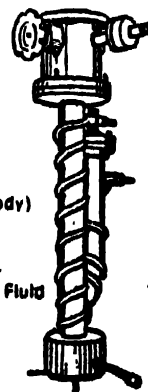
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Inland Rs. 60.00

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SCIENCE & CULTURE

February 1987/Volume 53/Number 2

A MONTHLY JOURNAL OF NATURAL & CULTURAL SCIENCES

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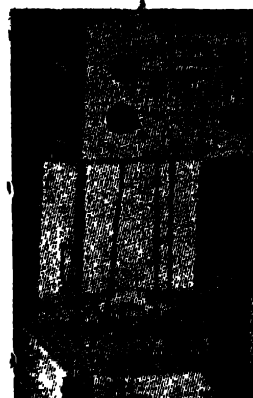
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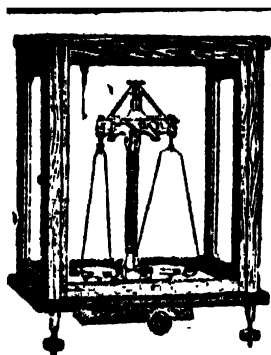


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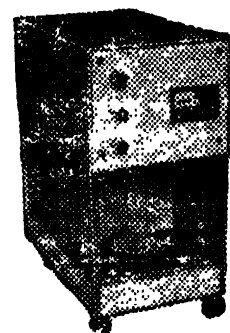
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DOES BRAIN DRAIN CONTRIBUTE TO THE LACK OF EXCELLENCE IN SCIENCE IN INDIA ?*

SCIENCE in general is international.

Scientists all over the world recognize it intuitively or otherwise. However, it is redundant to proclaim this international character as it is auto-evaluated. In Indian context, it is more than often asked as to whether the scientific research done in India has any global impact. The reason for this is the fact that innovative and scintillating news in science are not coming forth from India. Therefore, this question is raised over and over again. On the other hand, if the contribution towards international science from India is considered at the pre-independent era it gives totally different picture. Acharya Jagadis Chandra Bose discovered the microwave, solar cell with the concept of P and N junctions and in both the cases he was the pioneer and his contribution aided the further discovery which helped others in getting the highest laurel in the scientific field. Not only it helped others in getting the Nobel Prize in science, but his discovery revealed the scientific truth as well as utilization of the concept for the human welfare. Prof. C. V. Raman's discovery ultimately conferred on him the Nobel prize. Acharya P. C. Ray's, Prof. S. N. Bose's, Prof. M. N. Saha's and Prof. Homi Bhabha's names can be recalled with great pride in the context of international science. They are very much in the history of science. During the post-independent era the contribution towards the total scientific discoveries by the Indian scientists is not very encouraging. Since

during that period a large number of scientists and technologists from India migrated to other countries, naturally the question arises as to what extent the brain drain is the cause for the lack of excellence and world leadership in science in India.

Brain drain and its perspective

Migration abroad in pursuit of scientific career is not new. Educated men have been migrating across political boundaries for many centuries. However, in recent years the flow of migration from one country to other has increased tremendously and perhaps this creates a problem. This problem is not restricted only to India or under-developed countries but this exists also in the developed countries. It is evident, starting from the late fifties there has been a systematic migration of a large number of scientists, technologists and medical graduates from India. For example between 1956 and 1970, records show that about 9,200 trained scientists, doctors and engineers migrated from India to U.S. only. This brain drain, in fact, still continuing, is costing the country heavily each year because of the country's investment in rearing, educating and training them before finally losing them to another country. The U.S is the largest beneficiary mainly because there is demand for trained

*Lecture on the occasion of 51st Annual Meeting of the Indian Science News Association.

personnel in that country which has vast and still expanding research and development activities in several fields. It now appears that about 20% of scientists and technologists who migrated to the U.S.A are Indian's. Obviously, the rest is coming from other countries indicating that the problem of the brain drain is not inherent to India alone. What is then the reason for scientists to migrate to U.S.A. in such a large number? Because migrants benefit more economically in U.S. owing to better pay, higher standards of living, and the availability of every facility and amenity. The prime factors which bring about migration from one country to another are economic, administrative, political and social. India is producing many more trained personnel that it can possibly use; under-employment is so great among trained personnel that graduate engineers doctors and scientists are accepting employment in banks and other places as clerks/assistants. The news flashed that India, the world largest donor of medical manpower, has suffered an investment loss of \$144 million as a result of large scale migration of Indian physicians. Is it the picture that this migration is only costing us financial loss or does it cause any imbalance in the whole set up? If India produces more scientists and the extant machinery cannot provide suitable employment to them or cannot persuade them to go to villages or less developed areas there is no other way to prevent them from migrating. So, it cannot be the major problem in building up the excellence in science in India. However, due to large number of migration India is losing potential leaders in science. True, only a small number of such leaders can be counted in this large emigre group, yet whatever the small number is this it is a great loss to the country. Next question then arises is there any surity that those who became the leader in the field of their choice could have been so if they would stay back to this country? It is difficult to test those queries directly. What could be argued is that many com-

petent people have stayed back to try out in India but under the conditions prevailed in India after the independence did not make any superstars. Therefore extrapolating this trend it could be said that the same thing would have happened with those leaders of Indian origin in other countries if they would not have migrated.

The falacy is that the Indian scientific tradition dates back to ancient times. There was a time when India was recognized as a centre of learning, and the people from far and wide used to come to India to widen their knowledge. Indian scientists made an appreciable contribution towards the development of science in those days even as early as 5-6 decades back. Unfortunately, India has gone through a period of subjugation which saw the destruction of this scientific and technological tradition. That tradition was gradually forgotten and as a result no definite school of thought was developed or whatever expertise gained out of the contributions of Indian scientists was not retained. As a result India became backward and socio-economic conditions have eaten away the vital of it.

There were exceptions and those few exceptions are illustrious ones because even under the foreign rule scientific contribution from India made an overall impact to the scientific world because at that time science was individualistic. Gradually science was moving at a pace and approaching towards such a complexity that the novel approach to the solution of a problem needs efforts from a group of people, i.e., a team spirit and well coordinated work are needed for contribution of anything concrete to science. The team work was nonexistent or very poorly cultured in India. More and more resolutions of the problem was needed to establish the new concept. Sophistication in instruments was required, technology was fast advancing whereas innovative approach was lacking and the gap in the frontiers of

science was widening. Number of scientists was increasing without checking the quality and to absorb them, innumerable facets of science and technology were encouraged at a time with minimum grant available. Repetitive work became a fashion so that the scientists in India could publish papers in greater number. Neither there is any mechanism to prevent it. Publication-wise India occupies now the first place among the developing countries. But the citation index gives a very low key suggesting lack of impact to science as a whole out of those high number of publications. The questions may again be asked as to whether India is losing too many of potentially leaders of science. This is difficult to ascertain because there is no certainty that those potential scientists from India who have been the world leaders today had they been working in India.

Steps to be taken to reduce the brain drain

There are five dimensions to the brain drain problem (i) the facts—that is definition and description of the phenomenon, involving educational structure, its impact through time and its distribution through space, (ii) hypothesis about causal relationships, suitably disaggregated and specific, (iii) technical judgements about the relative weight of the brain drain in explaining "technological gap" or the problem of economic development, (iv) a choice of perspective for making judgement looking at the phenomenon—(a) from an international economic view point, (b) from a national view point, (c) from the view point of individual human rights, and (v) the morality of the problem. It is not the purpose to discuss all in details here.

The brain drain from India in fact touches all these aspects of the phenomenon. A central theme is that the principal causes of the brain drain lie within the losing countries

themselves. The only country that seems immune to the brain drain is France and the reason is simple. Frenchman in his right mind would exchange life in France for life in the U.S.A. There is not much in it so far as money is concerned—and everything else favours France. India presents an altogether different picture. Everything else in U.S.A. or other developed countries favours the migration from India.

A notable success has been achieved in persuading Indian scientific and technical personnel who have gone abroad, to contribute to the development of their own motherland. This aspect of the problem had been too much over-emphasised as to become an obsession. There is lot of talk about brain drain but very little was said about the brains that were dedicated to the service of the country. This ought to be emphasized. On the other hand, one should not be silent over return flows, which in many countries are large, specially in India. The problem may be looked as not produce large number ; to reform educational system; to regulate the flood of people being allowed to Universities and to retain them in the country by altering the prestige-ranking of occupation ; by providing more flow of money to research ; by generating the absorption capacity, that will provide satisfying employment for educated elites. Brain drain is identified more as an overflow of unusable graduates from inflated and irrelevant higher educational systems than as a drain of scarce resource, at best for most of the less developed countries. It is only when one moves up close to the problem and looks at migration of the elite-irreplaceable men—that one sees a drain that hurts. As a result most of the migration statistics sound alarming on a numbers problem that does not exist and are silent on the real problems of critical individuals and educational and environmental reform. If the internal condition is satisfying more people will be willing to come back. However, the proportionality of brain

drain appears not to be linked with the building up of excellence in science in India. It is the socio-economical condition and the culture which is preventing at every step to attain an optimal level in scientific pursuit in India.

It is apparent that the present brain drain *per se* does not pose the problem in building up excellence in science in India. The problem lies with the social and cultural environments of the country. Even creation of a science city may not help in establishing the leadership in science. Science can not prosper in isolation. What could be done is to eliminate the unproductive and repetitive science and to cultivate the collective responsibility rather than individualistic one coupled with group training in sophisticated technology so that it can work in this country without any hindrance. Accountability should be set at every step. Management of science should not be mixed with the scientific excellence. Attitude towards science for global impact is to be developed to contain the useless scientific pursuits as well as to cultivate good science so that more and more scholars are attracted.

Nationally one of our current qualities of high esteem is power and authority. And the taste of power and authority are damaging the system immensely. The influence of social and cultural environment on creative science is not a subject amenable to the usual methods of science. But it seems likely that some socio-religious factors may have a strong influence on creative science in India. Thus this culture is a continuous thing. As gene propagates in gene pool leaping from one body to other through sperms and eggs, the cultural trait, unit of which may be given the name meme (Mimeme) in consonance with gene, also propagates in meme pool from brain to brain. That cultural continuity is perhaps lost in India. How and to what extent our Renaissance scientists were influenced by the then local socio-religious milieu we can not ascertain with confidence because no first hand study was carried out yet. But we can do it now for our own benefit. I think the Indian Science News Association may undertake this question of relation with the gene and meme. □

B. B. Biswas

RADIATION RESPONSE TO RICE CROP (*Oryza Sativa* L.)

—A REVIEW

LALJI,* PADAMAKAR**, P. N. TRIPATHI** AND D. M. MAURYA*

RICE crop production and their physiology in relation to weather, favourable periods of solar radiation and temperature etc have studied by different scientists including the importance of ionizing and non-ionizing radiation during the reproductive stage of rice. But no single weather factor or combination of weather factor could satisfactory predict the rice grain yield. Keeping these in mind the present review highlights the effects of solar and ionizing radiation on rice crop providing other weather factors are not limiting

There is a great problem in improvement of rice production in Uttar Pradesh because of almost complete dependance (of about 70%) of rice crop in the State on monsoon, which is highly erratic and uncertain in most parts. Poor irrigation, drainage facilities and occurrence of natural hazards like drought and floods may also suppress the rice yield.

Dry seeding starts from late May and continues up to the end of June. During this period soil and atmospheric temperatures remain high (38°C) that damage the seed quality and germination potential. Kharif crop grows in low-temperature regime which decreases from 37.8°C to 23.9°C at 5 cm and 36.8°C to 23.3°C at 15 cm depth of soil from June to December. The mean atmospheric temperature during this period ranges from 33°C to 21.5°C. Such temperature of range does not appear limiting for tillering and growth of rice. High humidity during August increases the population of gall midge and leaf hoppers insect at 28°C in September. But extent of damage

in general, is low and humidity does not appear limiting.

Solar intensity on rice crop development

The arid regions are characterized by predominantly clear skies during both day and night, permitting a large amount of solar energy to reach the earth. Solar energy provides two essential needs of plants. (i) Light required for photosynthesis and for many other functions of the plant, including seed germination, leaf expansion, growth of stem and shoot, flowering and even dormancy. (ii) Thermal conditions required for the normal physiological functions of the plant. However, radiation also increases evapotranspiration. Transpiration rates increase in proportion to the intensity of solar radiation, while, in many crops, the rate of photosynthesis increases less rapidly¹⁶. The formative processes under the influence of photoperiodism are usually influenced by photosynthesis at high-light intensities²¹. At low-light intensities, there is a linear relationship between light intensities and rates of photosynthesis. Theoretically, photosynthesis is possible at any light intensity, however practically respiration dominates when light intensity is too low. Net assimilation will be zero at a light intensity of 500 fc, and a minimum of 500 to 1000 fc is required for effective rates of photosynthesis at which the

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photosynthetic gas exchange is greater than the respiratory gas exchange²⁰. With increasing, light intensity, photosynthesis of the single leaf obeys the law of diminishing returns, extremely high light intensities even have the inhibitory effect on photosynthesis a phenomenon called solarization²¹. Light is not spread uniformly over the photosynthetic surface in the field, but commonly passed by reflection and transmission through several layers of leaves. Its intensity decreases exponentially with the path length through absorbing layers. The fully exposed leaves in the canopy may absorb several times the amount of light needed for saturation, thereby absorbing a large proportion of the available light energy without increasing photosynthesis. The intensity of light falling on the leaves in the lower layers depends on the initial light intensity ratio between direct and diffuse light, or the number and size of the leaves their angle of incidence, and distribution and also on the transmission and reflection of the leaves²². Difference between actual yields and the calculated potentials yield in rice was high. This might be due to the maximum possible conversion of light energy into chemical energy by the photosynthetic process. It appears that light saturates at the upper part of the canopy while the lower leaves may be contributing very little on clear days and possibly show a negative net assimilation on cloudy or rainy days⁹. In most crop plants, light saturation for single leaves is reached at a light intensity of 0.2 cal cm²/min, which is typical of the light intensity on an overcast day with the sun at its zenith. On a clear day light intensity may be four times as great, so that a large proportion of the light is far in excess of what fully exposed leaves can utilize²³. The productivity of rice increases with light intensity till light saturation does not occur. Productivity was found to show a linear relationship with the logarithm of relative light intensity²⁰. The visible light, which has no direct effect on evaporation, affects

the rate of transpiration by influencing stomatal aperture⁸. In rice cv. Norin 18 low-light intensity is required for floral induction. A photoperiod of 9-12 h was most effective for floral induction, while no flowering occurred with photoperiods of <2 or >15 h. A two hour exposure to 463 nm, 541 nm, 700-900 nm light, but not 653 nm wave length light, just before a 10-h dark period increases the flowering response in comparison with day light⁵

Solar radiation on photosynthesis

Solar radiation plays a central role not only in the spikelet formation, grain filling and ripening but also in water and nutrient uptake of rice plants. The total radiation is affected by seasonal changes of rainfall distribution and the day length. For example, the increase in rainfall along with a decline of day length in August-September causes a pronounced drop of total radiation by 313 cal/cm² day⁻¹. Rainfed cultivated rice during the rainy season receives a total radiation of 380-420 cal/cm² day⁻¹ in tropical regions in comparison with irradiated rice cultivation in the dry season. This is probably a case of generally lower grain yields of the rainfed rice in humid tropical regions. However, low solar radiation is less adverse to upland rice in comparison with drought stress.

Many factors, such as the amount and kind of cloud cover fog, air-pollution and the colour of the foliage interrupting light, influence the quality of the incident light. Radiation up to 0.25 μ (Ultraviolet spectrum) is harmful to most of the plants, from 0.30 to 0.55 μ it has a photoperiodic effect, and from 0.40 to 0.69 μ it is most effective in photosynthesis. Above 0.74 μ (Infrared spectrum): 'Light' has practically no effect on photosynthesis, but its main effect is thermal and consequently respiration is encouraged¹⁹. The greater part of absorbed energy must be able to dissipate in the form of heat causing the rapid increase of temperature over atmospheric. This dissipation of heat occurs by

thermal radiation from the leaf, removal of heat via convection, current and transpiration⁴. On a relatively cool day, the rate of photosynthesis follows the incidence of solar radiation closely, for both shaded and unshaded leaves. In contrast, on a warm day, the sunlit leaf stops photosynthesizing, resuming the process start only just before sunset. The shaded leaf, on the other hand shows only a slight reduction in its rate of photosynthesis during mid-day period, but keeps on photosynthesizing throughout the day, so that its total daily photosynthesis is three times as great as that of the sunlit leaf in sharp contrast to what occurs on a cloudy day¹⁴.

Radiation on rice yield

The stimulating effect of impulse-concentrated sunlight (ICS) and laser beams on yield and seed yield in cucumber seeds were irradiated with ICS for 45 min and also with a helium-neon laser, 2-3 weeks before sowing. Plants from irradiated seeds had a greater leaf-surface area and a large number of male flowers¹¹. The influence of temperature and solar radiation on growth, habit and yield of photoinsensitive rice cv. which were transplanted at 1-month intervals throughout the year to determine the effect of temperature and solar radiation on yield. The crops transplanted in dry season gave higher paddy yields in comparison to those transplanted in wet season. Yield, the number of grains/panicle and spikelet fertility were positively correlated with cumulative radiation during the ripening stage¹⁴. With the response of rice yield to solar radiation and temperature based on grain yield from irrigated-rice cultivars in 40 environments, regression models were developed. Predicted yield increased by 0.41 t/ha for an additional 100 mwh/cm² of total solar radiation. The rate of change in predicted yield was estimated as -2.1 ± 0.075 minimum in temperature, i.e. -0.68 , -0.38 and -0.08 at 19, 23 and 27°C respectively. Yield predictions are graphically summarised by yield response

curves and isoquant plots¹⁵. The relation between rice yield and photosynthetically active solar radiation during the seed ripening stage was studied. The period from average heading to average harvesting date in each prefecture, and photosynthetically active solar radiation (PASR) was investigated, using PASR data collected in 12 prefectures. Accumulated PASR was calculated by the summation of PASR on every day at each measurement site. Average yield (3.40-5.37 t/ha) was closely correlated ($r=0.769$) with PASR (6513-10861 cal/cm²) during the ripening stage, but not with temperature¹³.

Rice-crop response to ionizing radiation

The recovery effect of gamma-induced damage in germinating rice, after irradiation with gamma rays was studied. The application of caffeine and ethylene diaminetetraacetic acid before DNA synthesis delayed the repair response and inhibited repair in the flowering S phase⁶. The untreated and treated IR-c9 rice seed which was stored under normal conditions and tested for variability at regular intervals. It showed the decreased variability in untreated seeds after five months, while that of treated seed after the twelve months. Germination potential decreased from 90% to 10% in 6 months in treated seed while it decreased only up to 40% in untreated seed¹². Rice cv. Sonalee, produced by treating seeds of cv Pusa a-33 with EMS (Electromagnetic spectrum) was superior in plant height, panicle length, number of fertile grains per panicle, paddy yield per plant, 100 grain weight and protein content; it had Basmati like scent⁸. The heritability value for panicle length, panicle number, grain set/panicle, fertile grain number per panicle and fertility in M_3 derived grains treated with 200-Kr gamma rays were higher in the late-maturing mutants than in the early maturing mutants. In the M_3 , the heritability values for 1000-grain weight and heading date were 94.1%

and 88.8% respectively in the early mutants and panicle length and fertility were 83% and 74.6% in the late mutants respectively. Under 5% selection pressure, the heading date of early type is expected to be brought forward by 12 days and the 1000-grain weight to be increased by 4.1 gm³⁴. The effect of Co⁶⁰ gamma radiation on rice plants before the differentiation of the young panicle increased both mutations frequency and mutation spectrum in the M₂ at 3-5 Kr doses. The effect of radiation on mutation frequency in hybrid rice was studied in which the chlorophyll mutants was increased to 14-73% in the M₂. By irradiation of these mutants grain with 20-Kr gamma rays, albino content was increased to 68% with respect to control and heading was advanced by 1-3 days. The coefficient of variation of plant height was 10-13% compared with 7-13% in the control⁸. The effect of 10-Kr gamma rays on Gimbozu rice was evaluated in third and fourth generations after the final treatment. It showed that genetic variances for the seven quantitative traits were higher following the recurrent treatments than after a single treatment. For four characters including panicle weight and panicle number, the variances were higher after the second than after the fourth treatments. For all characters, the effectiveness of selection in the third generation after treatment, increased as the selection intensity was raised irrespective of the duration of selection and number of treatments. The estimated genetic gain from selection was higher after repeated treatments than after a single treatment, but the relationship between the effect of selection and number of treatments varied with the characters and the selection direction.

It is concluded that recurrent mutagenic treatments can be effective in accumulating mutation in minor genes at 10-Kr gamma rays and the best results were observed with no more than these treatments⁷. The hybrid-rice grains were more sensitive to

radiation than the parental grains and their subsequent development showed the increase in range of variation, mutation, frequency variation coefficient and heritability³⁰. The one M₁F₁ and two M₂F₂ generation from three crosses and their parents treated with 10-12 Kr showed different responses to radiation. Seedling height, grain-setting rate and seedling-survival rates were all lower in the hybrids than in their respective parents for all the treatments, but especially for the 40-Kr treatment the hybrid generations are more sensitive to radiation than their parents³³.

An optimized spread of solar radiation photoperiod was stimulating for different component characters of rice crop. Similar trend of ionizing radiation, i.e. gamma and x-rays was also reported for the stimulation of different genetic characters. Radiation protection and repair was also optimized at an effective dose to rice crop.

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A STRUCTURAL-FUNCTIONAL APPROACH TO THE PROBLEM OF ENVIRONMENTAL CRISIS

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PEOPLES' participation in the preservation of environment requires firstly, a large scale interaction between natural and social scientists and secondly the performance of certain functions to solve the present day crisis

The movement of history is dialectic. A dialectical process has three stages : thesis, antithesis and synthesis, each reflecting the state of existing social order. If the exploitation of natural resources through the application of labor, technology and capital is thesis, the problem of pollution resulting therefrom is antithesis, and cleansing of our environment, without curtailing the conversion of potential utilities to actual utilities is synthesis. The transformation from one stage of the dialectical phenomena to another involves a transformation in the pattern of social system. A change in the social system, however, cannot be effective, unless two of its subsystems, viz. political system and technical system respond positively to the variations.

The political system is a combination of structures performing those functions which come under the purview of social sciences. The technical system is composed of a set of structures that make use of natural sciences to answer questions that are capable of scientific solution. The contemporary conditions have brought about a greater degree of functional differentiation so that both set of structures operate in isolation, although they are subsets of one and the same social system

Under these conditions, the natural scientists have dubbed certain questions as trans-scientific. Such issues, they feel, transcend the limitation of scientific inquiry and hence should be left for the social scientists to be solved. Conversely the social scientists maintain that certain problems are devoid of political solutions and hence be resolved by natural scientists. Environmental

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crisis is one such issue which both the scientific communities relegate to each other and thus avoid their respective responsibilities.

For example, in his article, 'The Tragedy of the Commons', Hardin¹ has asserted that the problem of environmental crisis has no technical solution, although technology may be able to buy time during which certain political solutions may be attempted. However, according to Crowe², 'under contemporary conditions, the subset of technically insoluble problems is also politically insoluble'.

Let us ask ourselves : Is it feasible to transform the society from the hitherto anti-thesis stage to the utopian synthesis stage ? Under the conditions of functional differentiation and specialization, this question may be categorised as a trans-scientific one. Yet we should not forget that if we are to keep from killing ourselves in the next few years we must aspire to achieve this transition. Hence an attempt must be made to liquidate the insularity between the two sub-systems so that the one structure-one function type of relationship is done away with.

Here two important facts need be mentioned. First, a structure without any distinct function is of little social relevance. Second, certain functions can be best performed only when there is interaction between two or more structures. The social utility of such functions is proportional to the common area shared between the sub-sets representing these structures.

Turning to the thesis of this article, it may be stated that the interaction between political and technical systems is a necessary but not a sufficient condition for achieving the much desired and urgently required synthesis stage. We must emphasise, as to what functions these two subsets shall perform in collaboration with each other. I propose a six function scheme consisting of three input and three output functions. The input functions mainly express the attitude and concern of the people towards the pro-

blem and the extent to which they can influence the machinery of government. The output functions are largely governmental functions.

Input Functions

1. Socialization

Socialization involves shaping the pattern of individual attitudes towards the problem. It is the subjective realm which underlines or gives meaning to individuals' orientations which may be classified into three types :

- (i) cognitive orientations - which impart a knowledge of environment to the individuals ;
- (ii) effective orientations—which develop a feeling of attachment or involvement resolving environmental crisis ; and
- (iii) evaluative orientations—which involve interpretation or judgement of measures adopted for preserving the environment.

It is by virtue of socialization function that the individuals become increasingly rational, empirical and analytical in their approach towards the problem. Rational, because of cognitive orientations, empirical, because of effective orientations ; and analytical, because of evaluative orientations.

It requires an abundance of enthusiasm and initiative on the part of social and natural scientists to develop these orientations and to promote among the people an ideology of preservation. The latter is a logically organised system of values, beliefs and goals, tending to be all-comprehensive, which shall direct the people to put common interests above the individual or group interests. The ideology of preservation organises the people into what Rousseau called, the 'General Will'.

General Will is a common conviction of a common good ; a sense of possessing common interest. The realisation of a common good involves the infringement of the rights of individuals. Such infringements,

however, do not curtail liberty; rather they add on to its meaning. Freedom is a matter of adjustment. It must be properly reconciled with responsibility. It must be remembered that individual good can only be achieved when the good of others is also realised. If an individual surrenders his right to contaminate the environment for his personal good to the General Will, the latter shall reciprocate his right to live in a healthy surroundings as an indivisible part of the community.

The following examples³ shall reveal that while dealing with environmental problems, whereas the socialized people are guided by reasoning, the illiterate are carried away by mere emotions.

The Orient Paper Mills at Amlai, Madhya Pradesh, started production in 1965. Soon the Sone river, which received the fallout from the factory, became grossly polluted and its water became unfit for all domestic purposes. In 1970 the people, mainly tribals, organised themselves to press their grievances. The concerned authorities agreed to install a water treatment plant and the people were pacified. Three years later, a team from I. I. T., Kanpur found that the levels of pollutants in Sone river were above the prescribed limits. As a result, there was an increase in the death rates of cattle and fish, cases of foot infection had increased and milk yields had gone down. Unfortunately, before these findings could be publicized the management exploited the religious sentiments of the tribals and diverted their attention from the issue of concern.

The management of Rashtriya Chemicals and Fertilizers Ltd. (RCF) Bombay, however, could not find such a straight forward solution as it had to deal with an educated and aroused populace. The RCF plant was originally proposed to be located at Mandwa-Rewas which is just 12 km from the metropolis. In 1977, Bombay based Society for Clean Environment (SOCLEEN) protested the location of the plant and suggested Tarapur as an alternative. Subsequently, the site

was shifted to Thal-Vaishet. Although this did not completely satisfy SOCLEEN, nevertheless under strong protests RCF agreed to launch a series of protective measures including an increase in the Chimney height from 90 to 150 m, use of high quality coal and sulphur free natural gas and installation of monitoring equipment. SOCLEEN, needless to mention, has on its roles both the natural and social scientists.

2. Communication

A smooth administration of environmental policies is ensured only when the natural and social scientists come together on a common platform to debate issues, discuss alternatives and to communicate openly, honestly and free from the outset. The amount of interaction between the two structures, the volume of information passing through them, and the freedom from control that they may enjoy have important implications on the preservation of environment.

In context of environmental studies, the significance of communication function lies in its performance through the following three networks.

(i) Public information network—A well informed public is essential to solve environmental problems. Environmental information should reach the people with sufficient data and accuracy to convey the ill effects prevalent in present human practices. This will make the people aware of elites' action so that they may exercise a considerable degree of control over them. The public information is thus a two-way communication function. First, a transmission of knowledge about the hazards posed by a contaminated environment, and secondly a feed back from the public of the appropriate response⁴.

Zuari Agro Chemicals Ltd. Goa, started operations in 1973. Anticipating degradation of the city, three political parties viz, the United Goans, the Goa Pradesh Congress and the Communist Party of India voiced their concern to the local residents. A citizens anti-pollution committee, supported

by these political parties collected data on loss of cattle and fish and other ill effects and made it public. Faced with peoples' protest, the District Magistrate ordered the closure of the factory on April 19, 1975. Eventually, Zuari Agro Chemicals installed a water treatment plant under the supervision of Central Water Pollution Control Board. By that time, however, many coconut trees had begun to wither away and any delay would have rendered many paddy fields unfit for cultivation.

(ii) Early warning and monitoring network—The content of environmental data made available to the people is derived mainly from warning and monitoring network. A network of this type shall draw attention to the long range potential hazards and also indicate possible safeguards. Both the social and natural scientists must be willing to involve themselves in this process by detecting and publicizing desirable threats to the environment.

In the absence of an effective warning and monitoring communication network, the prime sufferers are industrial workers who have to handle hazardous substances everyday but know little about them. Workers' awareness of occupational hazards needs significant increase. Workers may have some awareness of hazardous substances they work with, but they normally do not have enough knowledge of their long term effects⁵.

A reference to the vinyl chloride episode⁶ shall reveal the importance of warning and monitoring communication network. In January 1974, B. F. Goodrich Company voluntarily revealed to federal and state officials that since 1971, three workers associated with polyvinyl chloride polymerization operations at its resins plant at Louisville, Kentucky, had died of angiosarcoma of the liver. Since this form of cancer is extremely rare, the disclosure caused an immediate reaction among environmental administrators. By May 1974 a cause and effect relationship between vinyl chloride and human angiosar-

coma came to be accepted. It is now generally agreed that had B.F. Goodrich not reported the deaths of its Louisville workers several more years would have elapsed before the danger of vinyl chloride could have been established.

In case of a natural calamity like temperature inversion, the warning and monitoring system shall issue notifications incorporating immediate safeguard measures, and avoid large scale panic and casualties.

(iii) Operational information network—For making effective policies, an environmental administrator needs an operational information network which shall make him aware of a variety of factors such as local physical conditions, attitude of people and material available for action. Accurate and relevant information is also needed to determine the progress in implementing the environmental policy. The operational information network also ensures that impending environmental problems are promptly recognized and widely discussed as soon as they are perceived.

For example, recently the Uttar Pradesh Pollution Control Board reported that effluents discharged from three Dehra Dun based industries viz., the Adiya Chemicals Ltd., the ARC Cement and the UP Calcium Carbide Ltd. were toxic and injurious to health. As a result, on July 15, 1986 the subdivisional magistrate imposed section 133 Cr. P. C. against the three concerns and ordered their closure. Hopefully, this seems to be the first step towards the preservation of ecologically fragile Doon Valley.

3. *Interest articulation*

Interest articulation is the process by which individuals make demands on decision makers. This function ensures fullest possible participation by citizens in the decisions of their government. Like any other function, the articulation of interests is performed by a structure or a combination of structures. However, while referring to this function, I shall use the term interest group rather than structure. From the point of view

of environmental studies, the interest groups may be classified into two types : institutional representing the political system and associational representing the technical system.

According to Edmunds and Letey⁴, a pragmatic way to perceive the whole system design is through public participation and ascertaining their social choices. The people have jurisdiction co-terminus with the whole social system because they have reserved the rights of sovereignty under the constitution. When isolated from each other, the institutional and associational interest groups represent their respective subsystems but not the whole social system. Under these circumstances the decision makers encounter an organisational difficulty in not having direct access to those who represent the entire social system. However, when the institutional and associational interest groups collaborate with each other, the decision system shall look to the public for key decisions as to value, worth, cost, performance and preferred approaches to environmental improvement.

For a meaningful articulation to take place, two elements must be present : Common interest and issue of conflict. Without common interest, there is nothing to articulate for and without issue of conflict there is nothing to articulate about. Articulation for common interest is meant to bring some positive benefits to the community. Articulation over an issue of conflict is meant to prevent or counteract an action of decision maker which is likely to hurt the interest of the community.

I shall emphasise the importance of common interest and issue of conflict through a case study, relevant to the environmental problem. In the beginning of this decade the state government announced the construction of a hydro-electric power station across a natural resort in Kerala (South India) called Silent Valley. Both the institutional and associational interest groups under guidance of Kerala

Sastra Sahitya Parishad, voiced concern over the project since it was expected to wipe out the natural habitat in this region to quite some extent. The reaction against this project was so strong, extensive and widespread that the government was pressurised not only to abandon the project, but also to announce that Silent Valley shall be converted into a national park.

Clearly, the common interest in this case was to preserve the ecological balance of the region and the issue of conflict was to counteract the actions of decision makers that were detrimental to natural equilibrium.

If the people can articulate their demands through the interest groups, the decision makers can also pressurise the concerned interest through these very groups. Take for example the case of National parks ; their constant erosion has become a cause of concern for the environmentalists. Hardin states, 'At present they (National parks) are open to all without limits.....The value that visitors seek in the parks are steadily eroded. Plainly we must cease to treat the parks as commons or they will be of no value to anyone'.

Hardin suggests that on the basis of same criteria, only a few should be allocated the right to enter them. However, a democratic government, sensitive to public opinion, shall on its own never take such a decision and 'invite trouble' for itself by deliberately creating a 'privileged class'. Nevertheless, the government can make an appeal to the people, through the interest groups that such a step shall be in the common interest of all. The interest groups being repository of the interest and welfare of all shall supplement this appeal.

Output Functions

4. Interest aggregation or rule making

The conversion of group interests and group demands into definite polity alternatives by the decision makers is the function of interest aggregation. The demands which have been articulated undergo a process of suitable combination, accommodation

and compromise for their proper aggregation. The line of separation between interest articulation and interest aggregation is sometimes quite diffuse. Articulation is the expression of interest at a lower informal or formal group level. Aggregation is a combination process which deletes superfluous demands, resolves inner contradiction and presents clear policy alternatives.

The institutional and associational interest groups on one hand and the legislature on the other mediate between the great range of articulated interests and the final making of rules. The legislature is an amateurish body. It generally drafts the outlines of the rules, the details being filled by specialized agencies. It is suggested that the delegated legislation should be left to the representatives of associational and institutional interest groups in the governmental bureaucracy so that the decisions may represent the best possible reconciliation of many different interests.

The decision process must encompass the interaction of human activity with the entire ecosystem. It must not represent a sectional interest. The ecological degradation which we experience today, its chemicalization, pollution and hazards to biological health, is a consequence of segmented decision making without discerning the design or states of the whole socio-system⁴.

To enact appropriate legislation for a better environmental administration, the prime requisite is a leadership showing concern towards the problem and committed to long term planning. Those involved in decision making generally concentrate on immediate crisis. However, to check environmental crisis, we require widest, broadest, long term planning with its continuity ensured. As Spilhaus⁷ has said, "Only by ensuring a continuity of long term planning in our government can we hope to build toward the harmony of a bountiful economy and a beautiful environment."

As a part of long term planning, the government should conduct a thorough

assessment of all research projects concerned with environmental studies with the aim of speeding up high priority projects and weeding out those deemed unproductive. It should also formulate a comprehensive policy for hazardous and polluting industries.

The decision makers must also refer to the conditions and factors that are beyond the territorial boundaries of the nation-state. For example, while enacting legislation with regard to toxic substances, reference must be made to international developments in fixing their permissible, acute and chronic exposure levels. Thus the government should be willing to reveal greater openness to international scientific arena. Here, I appreciate the stand taken by the Government of India which seeks closer scientific collaboration with western nations in particular U.S.⁸. The scientific cooperation agreement signed by former Prime Minister Indira Gandhi and President Reagan in Washington in 1983 and the extension of the agreement signed by Prime Minister Rajiv Gandhi in June 1985⁹, for example can enable both the countries to pool their efforts for attempting to resolve environmental crisis, which of late has become a subject of international concern and importance.

5. Rule application

With reference to the pollution problem, rule application means to apply the techniques of epidemiology, preventive medicine, public health and industrial hygiene as corrective measures where the environment is contaminated and as preventive measures where it is likely to be contaminated. Unfortunately, the prevention of further ecological degradation is only a small portion of the abatement problem for it is far easier to prevent pollution than to correct it after it has occurred.

For example aquatic systems that are overburdened with toxic contaminants shall be a cause of concern for a considerable time, even though the further drainage of pollutants is shut off. Before the toxins are

depleted, fish will continue to accumulate them in large concentrations and humans will have to be careful of how much fish they consume. In such cases it is advisable to give up the contaminated water system for food production until it is able to cleanse itself and to institute widespread and effective monitoring network so as to prevent the creation of new ones. Perhaps this shall be the most effective control measure, although it reflects a negative approach.

It is also necessary to prevent the release of hazardous chemicals as wastes by instituting recovery procedures. For example, the discharge of mercury from chlor-alkali plants has considerably reduced following the use of diaphragm cell¹⁰.

Toxic chemicals in industry and agriculture should be replaced by less toxic ones. It should be ascertained that the dumped waste containing hazardous chemicals and their residues do not endanger the environment as well as the health of the people living in vicinity. Frequent monitoring of the environment for detection of significant levels of contaminants is an important step in this direction.

Those concerned with rule application must also review arrangements for planning, execution, monitoring and evaluation of major environmental projects and programs and make suitable recommendations so that without detracting from accountability, the decision making process is expedited, cost escalations and delays are avoided and optimum benefit is derived from the expenditure incurred on ecological ventures.

6 Rule adjudication

While discussing the socialization function, I stated that being a part of the General Will, an individual must not contaminate the environment to pursue his personal interests. General Will is imperative ; it must be obeyed by all and in order that it may be obeyed by all, it should be accompanied by physical compulsion. Law is an expression of General Will. It is the organised force of

government that carries the physical compulsion through.

The present day environmental degradation may be attributed partly to the inadequacies in laws relating to the environment and partly to the ineffectiveness of implementing agencies.

There is a need to formulate a set of new environmental laws which shall ensure that further degradation of environment is prevented without impairing efficiency or adversely affecting growth. For example, such measures should be instituted that make it cheaper for the polluter to treat his pollutants than to discharge them untreated.

There is also a need to give a new orientation to the existing environmental laws so that civil or criminal proceedings may be promptly initiated against the defaulters. The recently enacted Environmental (Protection) Act, 1986, for example gives sweeping powers to the Central Government to check the massive build up of pollutants in the Indian environment. Further, as a number of toxins have long-term and delayed effects, there should be a provision for taking such effects into account in fixing civil or criminal liabilities⁵.

There is a further need for setting up a system for participatory justice with defined jurisdiction and powers to ensure quick and economical disposal of cases pertaining to environmental administration.

The ineffectiveness in implementing the environmental laws sometimes arises because the agency responsible for rule application may manipulate the existing laws in favour of a clientele group whose economic interests would otherwise be adversely affected. As Lowi¹¹ has stated "the rules of game weigh heavily in favour of established interests". Hence the questions—*Quis custodiet ipos custodes ?*—'who shall watch the watchers themselves'.

To keep the custodians honest, the scientists have a major role to play, as far as environmental protection is concerned. Being a part of social system, they should

express their opinion as to what the law ought to be and its impact on the society. They should thus serve as guides for legislators and provide a means for filling in the gaps which certain incomplete aspects have created. The opinion of scientists are not decisions but mere arguments. However, when these arguments are repeatedly recognised they amount to accepted decisions.

On February 17, 1986, a three judge bench of Supreme Court suggested the setting up of environment courts on regional basis with one professional judge and two experts drawn from ecological sciences research group in view of the growing litigation over environmental pollution. The bench held that in most cases there is a need for neutral scientific expertise as an essential input to inform judicial decision making.

Though for over a century, the extensive developments in science have done much to unearth the secrets behind the process of nature, the scientists, by and large, have not felt concerned to ascribe value judgement to their findings. They have stuck to the traditional view that moral and ethical values cannot be supplied to scientific endeavors per se and that it is for the political leadership to judge whether a particular scientific achievement is 'good' or 'bad' for the society. The cultivation of science for improving human environment, however, requires a shift from the conventional stand. for the preservation of environment is concerned not with conquest of nature, but with co quest of ourselves.

When we ourselves are to be involved in conserving the environment, we have to look upon some form of participatory techno-

logy¹⁸ so that each one of us is included in the social and technical process of developing, implementing and regulating a technology for the said purpose. For participatory technology to materialise, it is necessary that those who understand science, however small their number may be, must realise that a scientific endeavor also has a social and ethical dimension. If the scientists bear social and moral responsibility of their work, they share an area of common interest with the political leadership. The interaction between political and technical system is necessary for the progress of all disciplines of science; but for the advancement of environmental studies perhaps it is most necessary.

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Notes and news

CFTRI develops improved machine for dehusking of pulses

The Central Food Technological Research Institute (CFTRI), Mysore, has developed a simple hand-operated machine to dehusk and split pulses on a small scale. It is more efficient than the wooden or stone *chakkis*, normally used in the rural areas, in yield (70-80%) and product quality and is comparable to bigger *dal* mills. It can process 40-70 kg of pulses in an hour, depending on the persons operating the machine.

The machine works on the principle of abrasion. It consists of a cone coated with abrasive substance and enclosed in a wire mesh which is fixed to the main frame. The pulse is fed from the top and after the abrasive action the *dal* and other products are collected at the bottom of the cone. As in the traditional methods the grains are given the usual pre-treatment of soaking and sundrying and then passed through the machine. After the dehusking, cleaning and grading of *dal* are done manually.

Though modern large scale, traditional *dal* mills and their improved versions by CFTRI are already in use in the country, about half of the pulse crop is still being dehusked and milled at rural homes. Thus, there is considerable scope for improved machines that can fit into the traditional pattern of labour intensive and low cost processing of pulses.

The CFTRI devised machine, which costs about Rs 3500 can become a viable and profitable alternative to traditional gadgets used by the village scale processor. It will enable him to improve the quality and yield of *dal*, and, thereby to market the product at competitive prices. □

CSIR News

Nuclear power programmes in developing countries

A group of 14 senior experts in the fields

nuclear power and financing will be issuing a report on its study of general requirements for the successful introduction and execution of nuclear power programmes. Particular attention is being given to the identification of requirements which, if not properly met, could constrain the introduction and enlargement of nuclear power programmes in developing countries. The experts, who met for the second time from 8-12 December in Vienna, are also studying possible mechanisms for assisting developing countries to overcome any identified constraints, and the Agency's role in these mechanisms. The group's report is expected in mid-1987.

Convened to assist the Agency with its work in this area, the group is composed of representatives, who serve in their personal capacity, from Argentina, Canada, China, Czechoslovakia, Egypt, Federal Republic of Germany, France, India, Mexico, Republic of Korea, Spain, Yugoslavia, the United States, and the World Bank. □

IAEA Newsbriefs

Nuclear energy applications in agroforestry studied

Although trees have been grown alongside crops for thousands of years, "agroforestry", as the practice is generally called, is just beginning to attract more widespread attention. Pressures on land—from rising populations, food demands, deforestation, and other factors—are helping to focus attention on the use of trees to protect and improve the fertility of soils.

One problem, however, is that there has been relatively little study of how agroforestry systems work and how they could be made to work better. For example, although nitrogen fixation by trees plays a key role in many systems, almost nothing is known of what affects this, what trees actually fix nitrogen, and how nitrogen fixation could be managed more effectively.

Some answers are likely to come from the use of isotopic and nuclear methods. At a

meeting in Vienna from 26-28 November, scientists met to discuss the potential of nuclear techniques in studying agroforestry systems. Participants came from 11 countries, the United Nations Food and Agriculture Organization (FAO), the Swedish International Development Authority (SIDA), as well as from the IAEA and its agricultural laboratory in Seibersdorf, Austria. Topics addressed included how to maximize nitrogen fixation and tree growth in restoring soil fertility and conserving soil resources, and examining differences between trees in water use efficiency and in productivity, an important factor in many countries of the world. Several recommendations were made on research priorities and in identifying specific roles of nuclear and related techniques in the field.

Particularly attractive for further research is the use of trees for rehabilitating and maintaining soils. In dry areas, trees are often able to use soil water not available to more shallow rooted plants. Once established, their perennial nature obviates the need for annual planting and also makes them especially good for holding soil against erosion. Besides being a source of wood and fuel, some trees can also be used as animal fodder. Above all, they may play an important role in anti-desertification. In wetter, humid tropics a number of nitrogen-fixing trees have been incorporated into agroforestry systems—for example, rows of trees alternate with several rows of crops in a practice called "alley cropping". The trees fix nitrogen, and are periodically trimmed, with the foliage used as manure for crops. □

IAEA Newsbriefs

INSA Bursary Grant Scheme

The Indian National Science Academy invites applications from individual scientists for the Bursary grant (non-recurring) which has been initiated by the Academy to provide *one time* supplementary support to individual

scientists for carrying out research effectively. The grant must be utilized for the purchase of equipment (if not available in the laboratory), components and accessories, chemicals and other such items concerned for research and/or to organise a small group discussion of professional colleagues on important aspects of research and development, or any other significant activity related to research. Under no circumstances shall the Bursary grant be used for attending conferences abroad or in India. The Bursary grant will not be periodic or recurring as this is a relatively small amount ranging between Rs. 10,000/- to Rs 20,000/- and in exceptional cases upto Rs. 40,000/-.

The objectives and scope of the Bursary scheme will remain dynamic and will be suitably changed to render it more effective based on the experience gained.

Application form for the Bursary grant may be obtained from the office of the Executive Secretary, Indian National Science Academy, Bahadur Shah Zafar Marg, New Delhi-110002 and may be submitted three months in advance. The applications normally get screened once in three months by a Sub-committee constituted by the Academy. □

Professor Hira Lal Chakravarty Awards – 1987

Applications in prescribed forms are invited from Indian Scientists, below 40 years of age on December 31, 1986 and with Ph.D. degree for outstanding published work in any branch of Botany for Professor Hira Lal Chakravarty Awards of Rs. 4,000/- each given by the Indian Science Congress Association. Forms and necessary information are available at the Indian Science Congress Association, 14, Dr. Biresw Guha Street, Calcutta-700017. Last date of submitting application is July 15, 1987. □

Letters to the editor

Possibility of use of saline irrigation water at different growth stages and its effect on grain yield and chemical composition in barley

Barley (*Hordeum vulgare* L.) is an important rabi crop grown mainly in arid and semi-arid regions which are generally affected by salinity of soil or irrigation water which is also scantily available. Previous studies showed variation, variation to salt stress in relation to growth and yield^{1,4,6}. It is also reported that germination and seedling survival was (100%) to salt levels upto 17 dSm⁻¹. There seemed hardly any attempt regarding stage sensitivity to saline irrigation water and its consequent effect on yield. Hence experiment was conducted in glazed leak proof pots by sowing barley variety CS 54 (A culture from our Institute) to test stage sensitivity to saline irrigation water so that it may be suggested at what stage of

growth, saline irrigation water can be profitably utilized. Plants were grown with normal irrigation water when at flowering and grain filling stage, saline irrigation water of E.C. of 2.5, 6.5, 10.5, 13.7 and 17 dSm⁻¹ was applied upto saturation of pot soil in five replicates. Plants were harvested at maturity, grain yield recorded and shoot samples were digested by diacid mixture and analysed for Na and K by flame photometer.

Results showed that grain yield in barley was reduced with increase in salinity of irrigation water but was drastically reduced when saline irrigation water was applied at flowering than at grain filling stage which suffered 50 percent reduction at E.C. 10.5 (Table 1), while straw yield was non-significantly affected showing thereby that grain formation stage in barley was more tolerant than flowering stage. Chemical analysis of shoot indicated that Na content increased with increase in salinity of irrigation water, but at flowering stage, barley accumulated more Na than at grain formation stage irrespective of salt treatment. Under salt stress also, similar trend was observed with comparatively lesser Na accumulation at grain formation than at

TABLE 1 : Effect of saline irrigation water application at different growth stages on grain & straw yield and sodium, potassium accumulation in barley (Var. CS-54)

Growth Stage	Grain yield (g/pot)					(a) Sodium (mg/g d.wt.)				
	Salinity of irrigation water					Salinity of irrigation water (E. C, dSm ⁻¹)				
	2.5	6.5	10.5	13.7	17.0	2.5	6.5	10.5	13.7	17.0
Flowering stage	11.6	9.2	5.2	1.0	0.3	9.4	24.6	28.5	33.0	40.9
Grain formation stage	17.6	20.5	16.5	15.8	13.6	8.9	15.9	22.0	25.7	24.9
	CD at 5% Salinity=3.08 ; stage 1.94 Sal. x Stage = 4.35					CD at 5% Salinity=9.29 ; Stage=5.88 Sal. x Stage = 13.15				
Growth Stage	Straw yield (g/pot)					(b) Potassium (mg/g.d.wt.)				
	Salinity of irrigation water					Salinity of irrigation water (E. C, dSm ⁻¹)				
	2.5	6.5	10.5	13.7	17.0	2.5	6.5	10.5	13.7	17.0
Flowering stage	21.4	23.1	25.2	21.5	21.1	26.4	20.2	17.1	16.4	17.1
Grain formation stage	20.2	23.5	22.8	21.9	21.3	27.0	28.0	24.8	27.8	23.5
	CD at 5% Salinity=NS ; Stage=NC Sal. x Stage=NS NS=Non significant					CD at 5% Salinity=3.02 ; Stage=1.90 Sal. x Stage=4.27				

flowering stage (Table 1). While K content decreased with increase in salinity but unlike Na, barely accumulated more K at grain formation stage than at flowering stage. Under salt stress also, K decreased at both the stage with much higher decreases at flowering than at grain formation stage when saline irrigation was applied at various growth stages. Salt sensitivity in barley had been related to higher Na and Cl and lower K in sensitive than tolerant variety^{1-3,5}. It appeared that salt tolerance in barley increased at grain formation stage which suffered least reduction in yield at various salinity levels and this tolerance in barley was attributed to comparatively low increase in Na content and less decrease in K in shoot at grain formation stage. It suggested that at flowering stage, only saline irrigation water of EC 6.5 may be utilized but at grain formation stage, even water of EC 10.5 may not cause substantive harm in barley crop.

Author is grateful to Director, for encouragement and Head, Division of Genetics & Plant Physiology for providing facilities for conducting above study.

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Revised : 10 February, 1987

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A study on measurement of leaf angle for irrigation scheduling in kinnow mandarin (*Citrus reticulata* Blanco)

More than 70% of the absorbed short wave solar radiation is converted into heat and is helpful as a source of energy for trans-

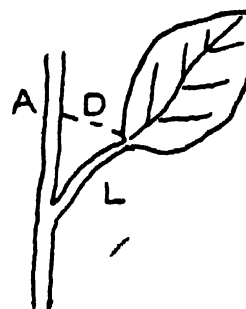
piration¹. As a result of short wave radiation and differences in the amount of soil moisture in the rhizosphere, a number of plant processes are effected. One such process affected is the angle of the leaf. In India, citrus growers apply water by flooding. It results in low-irrigation efficiency. The purpose of this study was to find out whether changes in leaf angle as a result of fluctuation in soil-water regimes can be used for irrigation scheduling.

A method of measuring leaflet movement in relation to incidence radiation in ground, not has been reported¹. In groundnut, the leaves are heliotropic and exhibit nyctinastic movement. The wing is very broad and prominent in grapefruit and pomelo. But in kinnow, the wing is rudimentary and almost non-existence and it does not orient according to incidence radiation. However, the pedicle of the leaf droops down under reduced soil-moisture conditions. Therefore, a formula¹ was used as a base and modified to suit the requirements of this study. The length of the petiole was recorded as shown in Fig. 1. Similar length was marked on the shoot having the leaf as shown as 'A'. The formula is given below.

$$\text{Leaf angle} = 2 \left(\sin^{-1} \text{of } \frac{D}{2L} \right)$$

where D=distance between A and the tip of the petiole (dotted line).

L=length of the petiole.



LEAF ANGLE

D= distance between A and the tip of the petiole (dotted line)

L = length of the petiole

— Fig. 1

To test the utility of this formula, correlation co-efficients and co-efficient of determination were worked out between changes in soil moisture and leaf angle under six irrigation schedules based on cumulative pan-evaporation values of 80 mm, 100 mm, 133 mm, 200 mm, 400 mm and control (no irrigation) during 1983 and 1984. A highly significant negative correlation (0.95) was observed between soil moisture and leaf angle. The leaf angle became wider as reduction in soil moisture was observed. The regression equation was worked out ($Y=50.5858 - 0.9846X$). The coefficient of determination was 91.98%, indicating that leaf angle can be predicted with great advantage on the basis of changes in soil-moisture regimes in kinnow mandarin plants.

The measurement of leaf angle for timing of irrigation can be very useful to the citrus growers of this country, since it is functionally easier and does not require the use of sophisticated equipments and can be carried out under field conditions without destroying the leaf.

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Role of proteolytic enzymes produced by certain keratinophilic fungi in keratin degradation

It is well known that fungal proteinases are active against a wide variety of proteinaceous substances. There are many reports of the production of proteolytic as well as other enzymes by various keratinophilic

fungi.^{1-5,10} The specific mode of their attack on the peptide linkage suggests that proteolytic enzymes have many practical implications. Increasing number of industrial uses for microbial proteases attest to this. The present study deals with the production of proteolytic enzymes by some of the keratinophilic fungi and their role in degradation of native keratin.

The selected fungi, *Nannizzia incurvata* Stockdale (+) as well as (—) strains, *Malbranchea aurantiaca* Sigler & Carmichael and *Botryotrichum keratinophilum* Kushwaha & Agrawal were grown in the medium containing glucose, 10 g ; gelatine, 10 g ; K_2HPO_4 , 1 g ; $MgSO_4 \cdot 7H_2O$, 0.5 g in 1000 ml of distilled water, pH 6.9. The optimum incubation period for the maximum production of proteolytic enzymes was found to be 20 days at 28°C. In order to know the role of proteolytic enzymes in keratin degradation, 2 keratin substrates viz, buffalo tail hair and chicken feathers were selected. They were cleaned and sterilized by 'dry autoclaving' method.³ 250 mg of each keratin substrate were weighed and substituted in the basal medium as the protein source. The 150 ml flasks containing 30 ml of basal medium were sterilized to which sterilized keratin substrates were added separately. The flasks were inoculated with inoculum disc of 6 mm diameter and incubated for 20 days at 28°C. In the same manner, a set of control flasks was also run without adding keratin substrates to the basal medium. Degradation of keratin by the test fungi was studied in two sets, one in presence of glucose and the other in its absence. Utilization of keratin by the test fungi through the production of keratinase containing proteolytic enzymes was assessed by 'weight loss' method,⁸ and the values are recorded in Table 1.

The culture filtrates obtained after the incubation period were used as enzyme samples. The enzyme activity was determined following the method of Meyers & Ahearn.⁹ The reaction mixture containing 0.5 ml of culture filtrate, 0.5 ml of citrate

TABLE 1 : Keratin utilization during proteolysis after 20 days of incubation

Keratin Source	Percentage of keratin utilized			
	<i>N. incurvata</i> (+)	<i>N. incurvata</i> (—)	<i>M. aurantiaca</i>	<i>B. keratinophilum</i>
Buffalo tail hair +	9.2	20.2	21.6	42.6
—	8.8	15.6	21.4	37.8
Chicken feathers +	1.8	1.6	17.4	34.4
	23.4	40.0	40.0	41.2

+ = in presence of glucose, — = in absence of glucose.

buffer (pH 6.0) and 1 ml of 1% case in solution in citrate buffer was incubated at 35°C for 20 mins. The reaction was stopped by adding 4 ml of 5% trichloroacetic acid (TCA). After 1 hr, the solution was filtered through Whatman No. 1 filter paper. One ml of filtrate was mixed with 5 ml of 0.4 M Na₂CO₃ solution to which 0.5 ml of phenol reagent was added. The tyrosine liberated in the filtrate was measured at 660 nm wavelength and the amount was calculated from the values of a standard curve of tyrosine. Each value was multiplied by 6 (since the total volume of the filtrate was 6 ml) and divided by 20 in order to assess the amount of tyrosine liberated per minute. One unit of enzyme activity was defined as the amount of enzyme liberating 1 µg of tyrosine per minute under the defined conditions,⁶ and the values are recorded in Table 2.

The amount of keratin degraded by these fungi was calculated in terms of per cent weight loss (Table 1). It is observed that the presence of glucose in case of buffalo tail

hair, increased the keratin utilization by all the fungi. On the contrary, the test fungi showed a considerable decline in keratin utilization of chicken feathers, in the presence of glucose. Noval & Nickerson⁹ also observed retardation of keratin digestion in presence of glucose in case of *Streptomyces fradiae*. Maximum degradation of keratin substrate during proteolysis was observed in *B. keratinophilum* (42.6%) in the medium containing buffalo tail hair. Other fungi in the order of their activity are *M. aurantiaca* > *N. incurvata* (—) strain > *N. incurvata* (+) strain.

Studies on the quantitative estimation of proteolytic enzymes reveal that the buffalo tail hair was preferred to chicken feathers by all the test fungi (Table 2). This indicates that the keratinophilic fungi, in some way, as yet unknown, are physiologically adapted to their particular substrates.¹ Among all the test fungi, *N. incurvata* (—) strain showed the highest enzyme production (4.8 units) in presence of buffalo tail hair in glucose. The

TABLE 2 : Protease production by keratinophilic fungi in the presence of some keratin sources.

Keratin Source	<i>N. incurvata</i> (+)		<i>N. incurvata</i> (—)		<i>M. aurantiaca</i>		<i>B. keratinophilum</i>	
	U	D	U	D	U	D	U	D
Buffalo tail hair +	3.525	227	4.8	199.5	3.375	196.0	4.275	143.5
—	2.025	228	2.625	211.9	3.0	196.5	0.9	155.5
Chicken feathers +	2.1	245.5	2.25	246.0	2.55	206.5	3.975	164.0
—	3.15	191.5	2.85	150.0	1.575	150.0	3.75	147.0

+ = presence of glucose, — = absence of glucose.

U = Units of enzyme produced (one unit is defined as the amount of enzyme liberating 1 µg of tyrosine per minute)

D = Dry mycelial weight in mg.

N.B. : Each datum given in the tables is an average of two independent determinations.

order of enzyme activity in other fungi is *B. keratinophilum* > *N. incurvata* (+) strain > *M. aurantiaca*. In case of buffalo tail hair, the enzyme production was enhanced by the addition of glucose in the medium. This was also the case with chicken feathers, except for the strains of *N. incurvata*, where the enzyme production was retarded by the addition of glucose.

It has been postulated that the rupture of the disulphide bonds between the two adjacent polypeptide chains is an essential step in the enzymatic degradation of keratin.⁷ Since the proteolytic enzymes produced by these fungi could appreciably digest keratins, it may be concluded that they are potentially capable to deteriorate the keratins. However, from these observations, there was no clear cut correlation between the amount of enzyme released and the amount of keratin the organisms could utilize.

The authors thank the Head of the Department of Botany, University of Saugar, Sagar, for facilities and the senior author acknowledges the financial assistance received through the University Grants Commission, New Delhi.

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Revised : 8 January, 1987.

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Chemical weed control in onion

Onion (*Allium cepa* L.), an irrigated closed-space crop, is seriously infested with weeds. Traditional method of weeding is labourious, time-consuming and expensive. Several chemicals have been reported to control weeds effectively, thereby increasing the crop yields by reducing the cost of production¹⁻³. The present paper deals with the effect of certain weedicides on weed population and nutrient uptake by weeds in onion.

A field experiment was conducted using onion variety Hissar-2 during 1984 at the Vegetable Research Station of Narendra Deva University of Agriculture and Technology, Faizabad. Recommended fertilizer and irrigation practices were followed during the course of experimentation. Fifteen treatments were followed, consisting of weedy-check (no weeding), repeated weeding, fluchloralin 0.75 and 1.0 kg a.i./ha, pendimethalin 0.5 and 1.0 kg a.i./ha and isoproturon 0.5 and 1.0 kg a.i./ha with one hand weeding followed at 40 days after transplanting with each chemical. Only fluchloralin was used at pre-planting, one day before transplanting whereas pendimethalin and isoproturon were applied at post-planting, one day after transplanting with light irrigation. The main weed species prevalent in onion crop were *Cyperus rotundus* L., *Cynodon dactylon* L., *Chenopodium album* L., *Eclipta alba* L., *Amaranthus viridis* Lima., *Euphorbia* spp, *Fumaria parviflora* Lamk and *Trianthema monogyna* L.

A representative sample of weeds was taken for the estimation of nitrogen, phosphorus and potassium. Nitrogen was analysed by the conventional Kjeldahl method.

Phosphorus and potassium contents were estimated using vanado-molybdate reagent and Flame Photometric methods respectively⁸.

Table 1 revealed that the maximum number of weeds were observed in weedy-check plot. All the treatments reduced the weed population and dry weight accumulation as compared with unweeded control. This was probably due to the efficiency of weedicides used, while in untreated plots weeds emerged with the first irrigation. Similar observations have been made by several workers^{4,6}. Fluchloralin 1.0 kg a.i./ha + hand weeding and isoproturon 0.5 kg a.i./ha + hand weeding were most effective in controlling the weeds.

Fluchloralin 1.0 kg a.i./ha + hand-weeding treated weeds removed the lowest amount of nutrients from the soil which was primarily due to the lowest weed infestation in that plot. All the weed control treatments increased the onion yield by 95.0-217.5 q/ha. Fluchloralin 1.0 kg a.i./ha + hand weeding produced the highest yield of 212.6 q/ha which may be due to the control of weeds from the time of transplanting till the crop, thus eliminating the crop weed competition and conservation of moisture, nutrients and space. Isoproturon 0.5 kg a.i./ha + hand weeding, although effective in control, reduced the bulb yield due to toxic effects. Fluchloralin 0.75 kg a.i./ha, with hand weeding, was the next best treatment, giving a total

TABLE 1 : Effect of weed control treatment on weed population, dry weight, nutrient uptake of weeds and bulb yield of onion

Treatment	Weed population per m ² *	Dry weight of weeds (g/m ²)	Nutrients removed by weeds (kg/ha)			Bulb yield (q/ha)
			N	P	K	
Weedy-check	17.9(320.8)	102.3	228.34	35.37	108.24	95.0
Weed free	2.8(7.0)	18.6	46.07	6.28	18.89	217.5
Hand weeding three)	15.5 (241.5)	94.3	211.16	26.36	91.14	202.6
Fluchloralin 0.75	14.8 (219.6)	37.7	195.92	30.30	96.12	200.9
1.0	17.2 (296.6)	64.6	219.23	30.31	98.96	190.8
0.75+HW	12.3 (150.2)	32.0	180.12	24.30	80.32	206.4
1.0+HW	10.6 (111.3)	27.3	173.23	22.10	69.32	212.6
Pendimethalin 0.5	15.4 (237.3)	45.6	198.63	31.77	89.21	193.9
1.0	15.1 (230.0)	54.3	193.60	30.98	84.78	197.2
0.5+HW	16.4 (269.6)	92.0	199.20	29.28	89.72	178.8
1.0+HW	14.3 (206.3)	61.3	186.36	28.23	80.97	204.4
Isoproturon 0.5	17.7 (315.0)	97.3	219.46	34.34	105.79	109.4
1.0	14.2 (203.3)	63.3	185.43	27.90	78.62	170.1
0.5+HW	11.3 (128.9)	43.6	178.10	24.21	73.39	162.3
1.0+HW	14.8 (219.3)	65.0	192.65	27.10	82.27	165.2
C. D. at 5%	5.3	20.9	30.8	7.1	16.6	19.7

*Figures outside the parenthesis are transformed values

HW=Hand Weeding

yield of 206.5 q/ha. Unweeded control, on the other hand, registered the lowest yield of 95.0 q/ha which was due to comparatively less availability of nutrients to the crop resulting from heavy weed infestation as mentioned earlier.

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Methyl green staining of DNA after selective extraction of RNA with cold Phosphoric acid

In a previous publication¹, the present author has reported that concentrated phosphoric acid at 5°C for 20 min when used on deparaffinised rat liver sections, brings about selective extraction of RNA leaving DNA in a depolymerised state. This statement was proved after staining the nuclei following treatment of sections in concentrated phosphoric acid with methyl green-pyronin which produced red nuclei and total absence of pyroninophilic component of the cytoplasm and the nucleolus. In several publications²⁻⁵, it has been reported that rat liver sections when stained with basic dyes after removal of RNA with cold 90% or 75% phosphoric acid for 40 min and 2 h respectively, reveal staining of the nuclei alone without any colouration of the cytoplasm. The present investigation reports on the use of methyl green for staining nuclei of rat liver

sections from which RNA has been extracted selectively with cold 90% phosphoric acid.

The dye used herein had been methyl green (E. Merck, G I. No 42585) belonging to aminotriarylmethane group. This dye was used as 1% aqueous solution and was purified with chloroform. The pH of the purified dye solution was 4.7. This pH was adjusted to 5.3 with a 0.01 N sodium hydroxide. Dye solution with freshly adjusted pH was used only. Staining involved deparaffinised formalin-fixed rat liver sections (8 µm) that were treated with 90% phosphoric acid at 5°C for 40 min then rinsed with water and stained for 40 min with the aqueous solution of methyl green at pH 5.3. Slides were then rinsed with water and dried between folds of filter paper, treated with n-butanol for 15-20 secs, cleared in xylene and mounted in DPX. Deparaffinised untreated control sections were stained for 5 min and in some cases for 40 min and then dehydrated through grades of ethanol or treated with n-butanol, cleared in xylene and mounted in DPX.

The *in situ* absorption characteristics of five stained nuclei were recorded with a microspectrophotometer⁷.

The result of staining liver sections with an aqueous solution of methyl green, after extraction of RNA with cold phosphoric acid, revealed quite satisfactory staining of the nuclei. Sections after extraction of RNA followed by staining for 5 min, when dehydrated through grades of ethanol revealed very few stained nuclei and the intensity of staining was far too less than sections stained for 40 min. Similarly treated sections when stained for 5 min and then treated with n-butanol revealed far better result as compared with those that were dehydrated through ethanol grades. Perfect result was achieved when phosphoric acid-treated sections were stained for 40 min and then treated with n-butanol after drying the slides between folds of filter paper. The control sections that were not treated with phosphoric acid but stained for 5 min and then dehydrated through ethanol grades revealed green nuclei

with little staining of the cytoplasm. Such sections when stained for 40 min and then dehydrated through ethanol grades revealed considerable staining of the cytoplasm as well as the nuclei. The control sections stained for 5 min and then treated with n-butanol revealed a much better result than preparations that were dehydrated through ethanol grades.

The *in situ* absorption spectrum of the green nuclei revealed the peak of maximum absorption at 600 nm (Fig. 1).

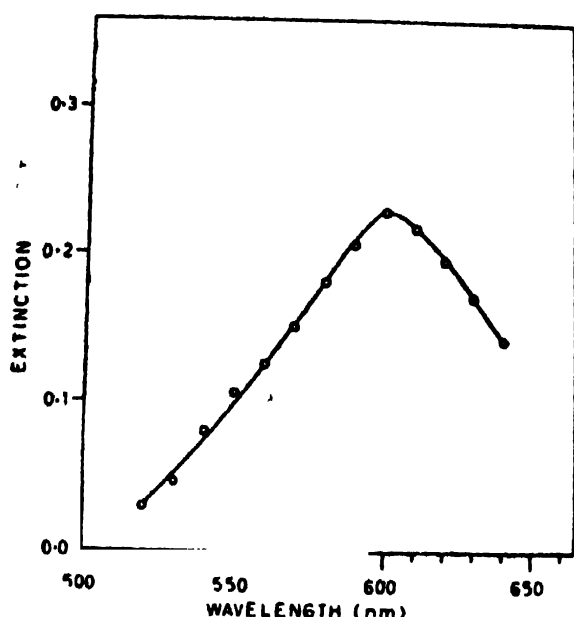


Fig. 1. *In situ* absorption characteristics of nuclei stained with an aqueous solution of methyl green following extraction of RNA of with cold 90% phosphoric acid.

From the above observations it is evident that DNA in the native state can be stained with an aqueous solution of methyl green following extraction of RNA selectively from sections treated with cold 90% phosphoric acid. Since it is known that treatment of sections in acids causes depolymerisation of DNA, as judged by the lack of green colouration of the nuclei following staining with methyl green⁶, it was proposed that depolymerisation of DNA does not allow this nucleic acid to be stained with methyl green which binds with the only highly polymeris-

ed form of DNA. In the author's earlier study¹, mammalian tissue sections were treated with concentrated phosphoric acid in the cold for 20 min and then stained with an aqueous solution of methyl green for 5 min, followed by dehydration through ethanol grades, then rinsed with water followed by staining with an aqueous solution of pyronin, dried between folds of filter paper, treated with n-butanol for 1-2 min, cleared in xylene and mounted revealing red nuclei only without any pyroninophilic component in the cytoplasm. In the present study, sections after extraction of RNA were stained with an aqueous solution of methyl green for 40 min followed by drying between folds of filter paper, then treatment with n-butanol for 15-20 secs, clearing in xylene and mounting. The difference between the two procedures lies in the fact that in the author's earlier study¹, sections after staining with methyl green were dehydrated through ethanol grades, whereas in the present study these were treated with n-butanol briefly. This difference in the procedure might have revealed lack of green colouration of the nuclei in the former case and consequently had given the impression that DNA was depolymerised due to treatment of sections with concentrated phosphoric acid as reported in the author's earlier study¹. In the present study also this statement has been found to be true, since phosphoric acid-treated sections, stained for 5 min with methyl green and then dehydrated through ethanol grades revealed nuclei majority of which remained unstained. Similarly treated sections when stained for 40 min and then dehydrated through ethanol grades revealed slightly better result. The best staining was possible when phosphoric acid-treated sections were stained for 40 min and then treated briefly with n-butanol revealing perfect green nuclei with no staining of the cytoplasm. Thus it is quite evident that sections after treatment in cold 90% phosphoric acid when stained with an aqueous solution of methyl green and then dehydrated through

ethanol grades shows signs of leaching of the dye from the nuclei, the leaching being prevented when similarly treated and stained sections are treated with n-butanol. This means that the solubility of the dye is more in ethanol than in n-butanol. Such a staining can, therefore, be considered to be due to the negatively charged phosphate groups of DNA with the positively charged dye molecules, according to the scheme presented in the author's earlier communication⁵.

The absorption spectrum of methyl green stained nuclei following staining with this dye after selective extraction of RNA has not been reported so far. The peak of maximum absorption of similarly treated and stained nuclei is recorded here to be at 600 nm. However, it is reported that the spectrum of nuclei stained following different procedures of staining by the same dye is in most cases different⁹.

Finally it is concluded that DNA after treatment with cold 90% phosphoric acid remains in a fully polymerised state since it can be stained specifically with methyl green without any staining of the cytoplasm.

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Antagonistic activity of actinomycetes against *Phytophthora drechsleri* Tucker f. sp. *cajani* from sewage irrigated soils

Certain soil microorganisms are known to produce various antibiotic substances which help in the biological control of soil borne

diseases in nature^{1,2}. In India there are many towns and cities where there is partial and open drainage system and domestic sewage is discharged into the small streams and rivers. This domestic sewage is utilized for irrigation of crops at the adjacent areas of the town. Domestic sewage is a rich source of nutrients and hence can be used for irrigation purpose, where less irrigation facilities are available. However, sewage-treatment may influence the soil microorganisms. Effect of sewage irrigation on rhizosphere and rhizoplane fungi of some crops is known from this laboratory³. The antagonistic population may also be affected due to sewage irrigation. A study was, therefore, carried out to see the antagonistic population of sewage irrigated soils around the town Aurangabad.

Phytophthora drechsleri Tucker f. sp. *cajani* Kannaiyan *et al.* causing blight of *Cajanus cajan* in semi-arid tropics, was selected for study. In addition *Rhizoctonia bataticola* causing root rot of various crop plants was also selected for the purpose of comparison. Double agar layer technique⁴ and spot inoculum tests were used in order to enumerate antagonistic population. Jensen's agar medium, Waksman's agar medium, and Thornton's agar media⁵ were employed for estimation of actinomycetes, fungi and bacteria respectively.

Total 10 soil samples, each from fresh water irrigated and sewage irrigated, were studied to see their antagonistic population. It is clear from the Table 1 that sewage irrigation increased total microbial population in the soil. Among these, bacterial and actinomycetes population was highly increased while fungal population was decreased. Fungal population was, however, variable due to sewage irrigation. In the fresh water irrigated soil fungi like *Aspergillus terreus*, *A. carbonarius*, *A. flavus*, *Fusarium oxysporum*, *Cladosporium herbarum* were dominant, while in the sewage irrigated soils *Aspergillus niger*, *A. nidulans*, *A. fumigatus*, *Penicillium funiculosum*, *P. verruculosum*, *F.*

TABLE 1 : Antagonistic population of soil microorganisms in sewage irrigated soils against *Phytophthora drechsleri* and *Rhizoctonia bataticola**

	Fresh water irrigated soils		Sewage irrigated soils	
	Total population	Antagonistic population	Total population	Antagonistic population
<i>Phytophthora drechsleri</i>				
Bacteria ($10^4/g$)	23.78	0.90	150.30	0.76
Fungi ($10^3/g$)	17.29	1.19	9.71	0.95
Actinomycetes ($10^3/g$)	29.39	0.45	42.03	0.34
<i>Rhizoctonia bataticola</i>				
Bacteria ($10^4/g$)	—	11.04	—	6.50
Fungi ($10^3/g$)	—	4.53	—	3.24
Actinomycetes ($10^3/g$)	—	7.46	—	2.02

*Average of 10 samples from the fields growing *Capsicum annum*, *Cajanus cajan*, *Medicago sativa*, *Pennisetum aurentifolia*, *Saccharum officinarum*, *Sorghum vulgare*, *Solanum tuberosum*, *S. melongena*.

oxysporum and *Trichoderma viride* were dominant. Other fungi were commonly observed in the fresh water and sewage irrigated soils.

There was variation in the population antagonistic to *Phytophthora drechsleri* and *Rhizoctonia bataticola*. Antagonistic population was higher to *R. bataticola* when compared with *P. drechsleri*. Sewage irrigation however reduced antagonistic population to both pathogens. In case of *P. drechsleri* fungal antagonists were much affected, while in case of *R. bataticola*, antagonists belonging to actinomycetes were much affected.

Spot inoculum test was carried out in order to find out antagonistic activity of 35 fungal isolates against *P. drechsleri*. Of these *A. niger*, *A. terreus* and *P. verruculosum* were able to antagonise the pathogen. Of the 35 bacterial isolates four gave maximum inhibition.

Detailed study was carried out with the 13 actinomycetes isolates, isolated from both the sewage and fresh water irrigated soils. All the isolates belonged to the genus *Streptomyces*⁶, and all of them were noted to be inhibitory to *P. drechsleri* when tested by spot inoculum test. Inhibition zone ranged from 8-30 mm on the agar plates without sewage (Table 2).

TABLE 2 Antagonistic zone of Actinomycetes against *Phytophthora drechsleri**

Actinomycetes isolates	Antagonistic zone (mm)
A ₁₃	8
A ₁₆	10
A ₁₈ , A ₂₁	12
A ₁₁	18
A ₁ , A ₇ , A ₁₇	20
A ₃ , A ₂ , A ₁₉ , A ₂₄	25
A ₁₅	30

*Spot inoculum test on glucose nitrate agar medium in the plates.

Isolate A₁₃ was selected for further study in order to find out the effect of sewage on the antagonism. Sewage was Seitz filtered and added to the glucose nitrate medium at different concentrations. A₁₃ isolate and the pathogen were inoculated side by side on the plates. Results in Table 3 showed that there was a decrease in the antagonistic zone with the increase of sewage concentration in the medium. An experiment was therefore, carried out whether soils irrigated with sewage reduced antagonism between the pathogen and the actinomycetes. Ten soil samples were collected from the fields irrigated with sewage since last 30 years. Aqueous

TABLE 3 : Effect of sewage on antagonistic reaction between Actinomycetes isolate A₁₃ and *P. drechsleri**

Proportion of sewage in the medium (%)	Antagonistic zone (mm)
0	28
25	17
50	15
75	12
100	8

*Spot inoculum tests on glucose nitrate agar medium plates (supplemented with various concentrations of sewage).

extracts were prepared and Seitz-filtered extracts were added in the glucose nitrate medium. It was seen that average antagonistic zone between the actinomycetes A₁₃ and *P. drechsleri* was brought from 23 mm to 12 mm. In addition growth of the actinomycetes was also reduced. This indicates that sewage or soil extracts of sewage irrigated soil is unfavourable for the growth of actinomycetes. But it can still tolerate sewage and can survive and produce a small inhibitory zone. It is also possible that many of the actinomycetes in the soil might have been suppressed in the soil due to sewage and only few numbers were observed on the agar plates. Certain domestic sewage components, inhibitory for the growth of actinomycetes be responsible to reduce their number in the soil. Co-inoculation of actinomycetes A₁₃ with *P. drechsleri* to a susceptible *Cajanus cajan* Cv Hy 3c, however showed nearly 52% reduction in the disease index under tap water irrigation. Therefore, biological control may be achieved in the fields where normal water irrigation facilities are available.

The authors are grateful to U. G. C., New Delhi, for providing financial assistance to M. Chaudhary.

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Received: 4 September, 1986.

Revised: 14 January, 1987.

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Response of wheat varieties to levels of nitrogen in mixed red-black soil

It is a well-known fact that dwarf wheat gave maximum yield under high levels of nutrient status in the soil, especially nitrogen¹. Besides increased production, the quality of produce is also important which is influenced primarily by a variety of crops, levels of fertility and their time of application, soil type and climatic conditions, etc.². So far no information is available on response of dwarf wheat varieties to levels of nitrogen under mixed red-black soil of Madhya Pradesh. The present paper deals with this objective.

Five varieties of wheat, viz. HDM 1593, HDM-1553, WH-157, WH-147 and Lok-1 were tested under three levels of nitrogen, i.e. 0, 40 and 80 kg/ha at J.N.K.V.V. research farm, Rewa, during the rabi season of 1981-82. The experiment was laid out in randomized complete block design with four replications. Net-plot size of 3.5 m x 2.2 m was selected and row-to-row spacing was kept at 22 cm apart. A basal dose of 40 kg P₂O₅/ha and 30 kg K₂O/ha was uniformly applied to all the plots. One-third of total nitrogen as per treatment was applied at sowing and the remaining dose of nitrogen

was top dressed in two splits, first at crown-root initiation stage and second at tillering stage. Irrigations were given to all plots as and when required. The grain-yield data reported were adjusted to 15% moisture.

N/ha produced 35.94 q/ha of grain yield and was significantly superior over other doses of nitrogen. Awasthi and Panta² also advocated that N @ 80 kg/ha is the most beneficial dose for wheat varieties. The dose of 40 kg

TABLE 1 : Response of wheat varieties to levels of nitrogen on grain yield and its attributes

Treatment	Plant height (cm)	Number of tillers per plant	Length of earhead (cm)	No. of spikelets per earhead	No. of grains per earhead	Grain yield per plant (gm)	1000-grain weight (gm)	Grain yield (q/ha)
Variety								
HDM-1593	93.49	2.03	7.66	11.70	32.33	2.04	30.67	21.30
HDM-1553	97.84	1.83	8.45	12.47	32.45	1.87	31.50	18.87
WH - 157	101.33	2.59	11.12	13.08	34.33	2.78	30.67	28.90
WH - 147	89.49	2.39	7.48	13.68	37.67	2.78	30.87	32.39
Lok - 1	90.46	2.14	7.79	12.15	35.67	2.83	32.33	24.81
C.D. 5%	3.34	0.31	1.73	0.75	1.36	0.56	0.69	2.35
Nitrogen level								
0 kg/ha	82.81	1.55	7.16	10.09	32.80	1.52	30.20	14.19
40 kg/ha	94.22	2.30	8.51	12.57	34.00	2.43	31.10	25.64
80 kg/ha	106.34	2.93	9.83	13.19	36.67	3.44	32.32	35.94
C.D. 5%	2.59	0.24	0.99	0.58	0.52	0.44	0.53	1.81

The varieties of wheat differed significantly in their yield potential (Table 1). WH-147 significantly out yielded all the other varieties by 32.39 q/ha. WH-157 occupied the second position. Lok-1 yielded lower than WH-147 and WH-157, but higher than HDM-1593 and HDM-1553. However, HDM-1553 yielded the lowest grain yield (18.87 q/ha). The difference in yielding-ability of wheat varieties may be due to variation in their genetic makeup and their adaptability of this region. The higher grain yield of WH-147 may be due to significant increase in their tillers/plant, spikelets/earhead, grains/earhead and grain yield/plant.

Increasing dose of nitrogen also significantly influenced the plant height, tillers/plant, length of earhead, spikelets/earhead, grains/earhead, grain yield/plant, 1000 grain weight and grain yield/ha. The application of 80 kg

N/ha also gave significantly higher grain yield over control. The increase under the 80 kg N/ha was 28.65% and 60.51% more over 40 kg N and control respectively. Increasing levels of nitrogen, allow the plant leaves to grow larger and hence have larger surface available for photosynthesis.

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Revised : 1 December, 1986.

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**A safer insecticide for the control
of spotted beetle, *Henosepilachna
vigintioctopunctata* Fab. on
Brinjal**

The spotted brinjal beetle, *Henosepilachna vigintioctopunctata* Fab., is a serious pest of egg plant (*Solanum melongena* L.) in India. Both grubs and adults cause direct damage to the brinjal crop by scraping the leaf tissues and resulting in a rapid defoliation. To control the pest, various insecticides like endrin¹, carbaryl²⁻⁴, and malathion⁵ have been recommended. Their large-scale use often disturbs the natural balance resulting in a number of secondary problems, viz. endrin is highly toxic to mammals and carbaryl results in secondary infestation of mites⁶. Therefore, studies were undertaken to find out a safer insecticide for controlling the spotted beetle of brinjal.

The experiments were laid out in simple randomised-block design with nine treatments and three replications, using the common

variety of brinjal, Pusa Purple Long. Plot size was kept 2 x 1.5 m and a spacing of 50 x 50 cm was adopted in all the plots. There were 10 plants in each plot. The insecticides listed were phorate (1.5 kg a.i./ha), carbofuran (0.5 kg a.i./ha), dichlorvos (0.05%), malathion (0.10%), monocrotophos (0.10%), phosalone (0.10%), quinalphos (0.20%), and carbaryl (0.20%). The first two insecticides were granules and applied in the soil and the rest sprayed over the plants. Control plot, was sprayed with water. The experiment were conducted during kharif seasons (1981-82). The first application of insecticide was made at the third week of plantation. The granules were applied twice in a month and the sprays were applied thrice at 15 day-interval in a season. Insecticidal effect of these insecticides were evaluated by recording the population data of spotted beetles from three randomly selected leaves (one top, one middle and one bottom) of each of five central plants in each quadrant. The salient results are as follows.

**TABLE 1 Effect of various treatments on the population incidence
of brinjal-spotted beetle during 1981-82**

Treatment	Dose	Kharif 1981		Kharif 1982	
		No. of grub/plant	No. of adult/plant	No. of grub/plant	No. of adult/plant
Phorate	1.5 kg a. i./ha	1.41 (1.55)	0.66 (1.25)	1.61 (1.61)	0.43 (1.18)
Carbofuran	0.5 kg a. i./ha	0.58 (1.25)	0.11 (1.04)	0.82 (1.35)	0.38 (1.11)
Dichlorvos	0.05%	1.25 (1.50)	0.55 (1.21)	1.15 (1.47)	1.50 (1.58)
Malathion	0.10%	1.11 (1.45)	0.50 (1.19)	1.48 (1.57)	0.70 (1.28)
Monocrotophos	0.10%	1.20 (1.48)	0.22 (1.09)	1.00 (1.41)	0.78 (1.31)
Phosalone	0.10%	0.66 (1.28)	0.59 (1.21)	1.12 (1.45)	1.65 (1.29)
Quinalphos	0.20%	0.76 (1.33)	0.50 (1.18)	0.95 (1.39)	0.26 (1.12)
Carbaryl	0.20%	1.13 (1.45)	0.83 (1.30)	1.2 (1.48)	0.60 (1.26)
Control	—	2.60 (1.90)	2.22 (1.67)	2.90 (1.97)	2.36 (2.18)
S. Error		0.22	0.37	0.32	0.26
C. D. (P; 0.05)		0.47	0.78	0.68	0.55

Figures in parenthesis are transformed ($\sqrt{X+1}$) values

All the eight systemic insecticides were found superior to control in reducing and keeping down the population of both morphs (grubs and adults) of spotted beetle. During 1981, among the insecticides, carbofuran followed by quinalphos was found to be effective in controlling the grubs and adults of the spotted beetle and during 1982, these two insecticides showed effective control in the grubs and adult morphs respectively. However, carbofuran was at par with quinalphos in most of the cases.

It is evident that carbofuran and quinalphos appear as effective treatment schedules in controlling the spotted beetles. Between these two insecticides, the former is most effective as it not only reduces the population volume of the pest but also being granular, minimizes the hazards relating to the application of insecticides and prevents the undesirable wastage of insecticidal deposit on the foliage by rains during kharif season. Such assumption gains further support from earlier findings⁶⁻⁷. Therefore, the use of carbofuran 0.5 kg a. i./ha in kharif season may

be recommended to afford better protection of brinjal crop from the infestation of spotted beetle.

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Errata

In January, 1987, page 29, line 37, equn. (10) read δ for σ ; line 38 read ν for γ and page 30, line 3, equn. (11) read ν for γ .

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(i) R. B. Walton and H. B. Woodruff, *F. Clin. Inst.*, 82, 924, 1949.

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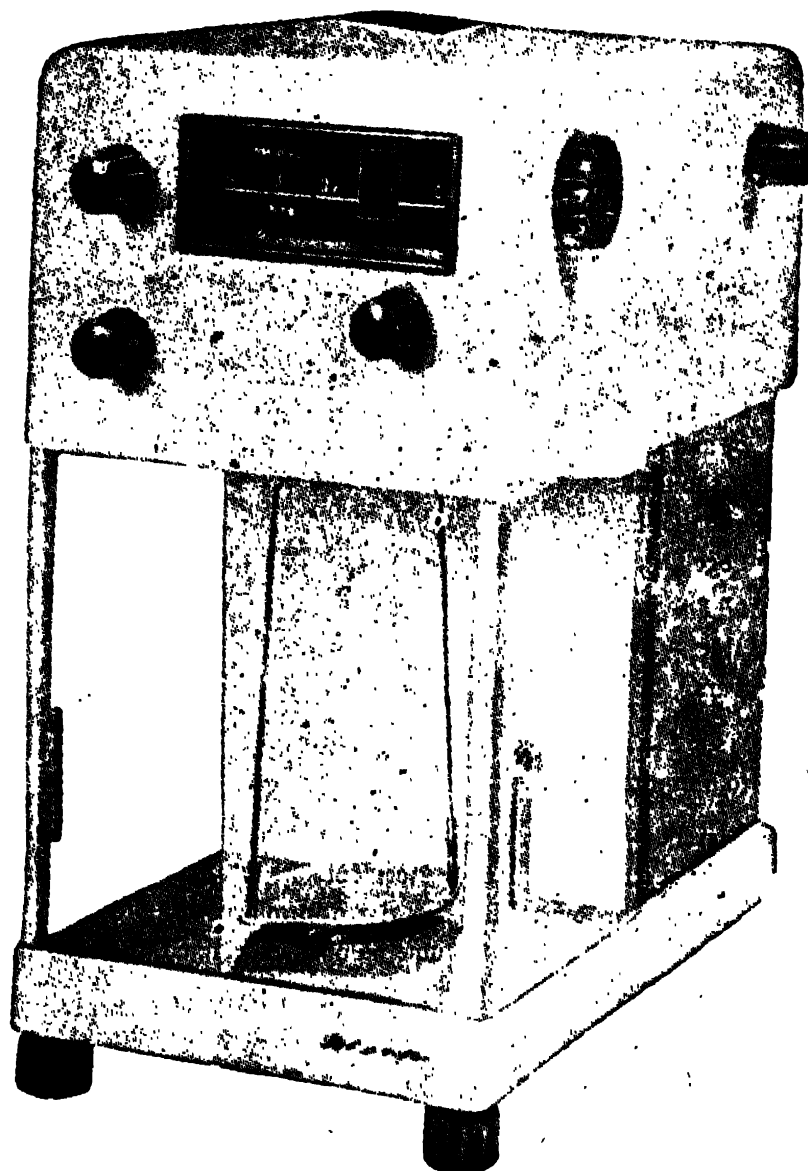
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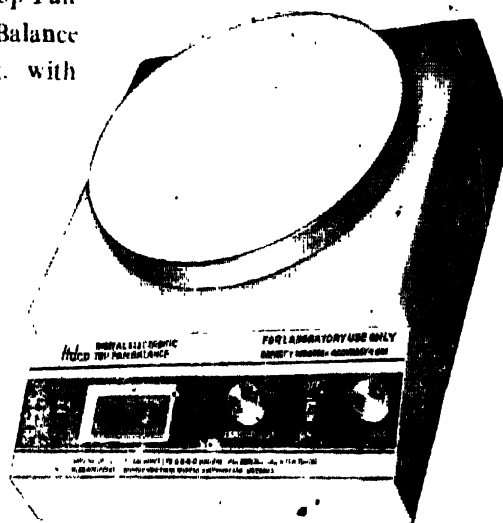
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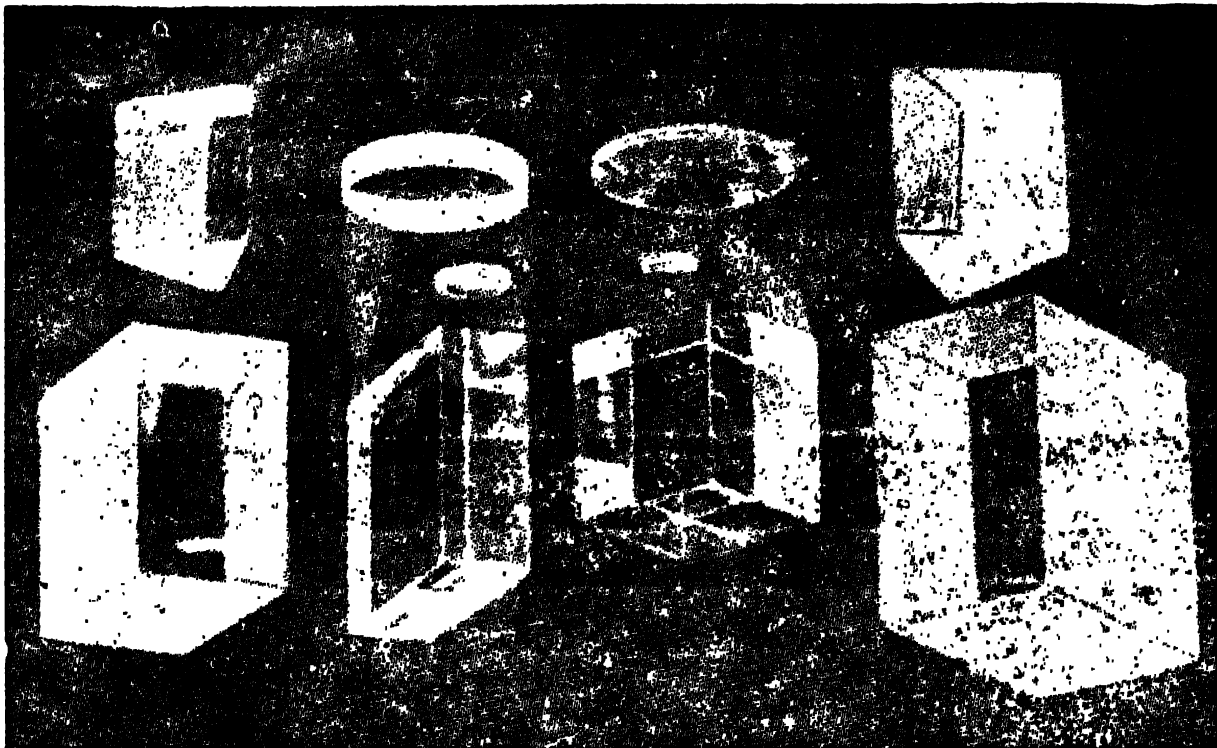
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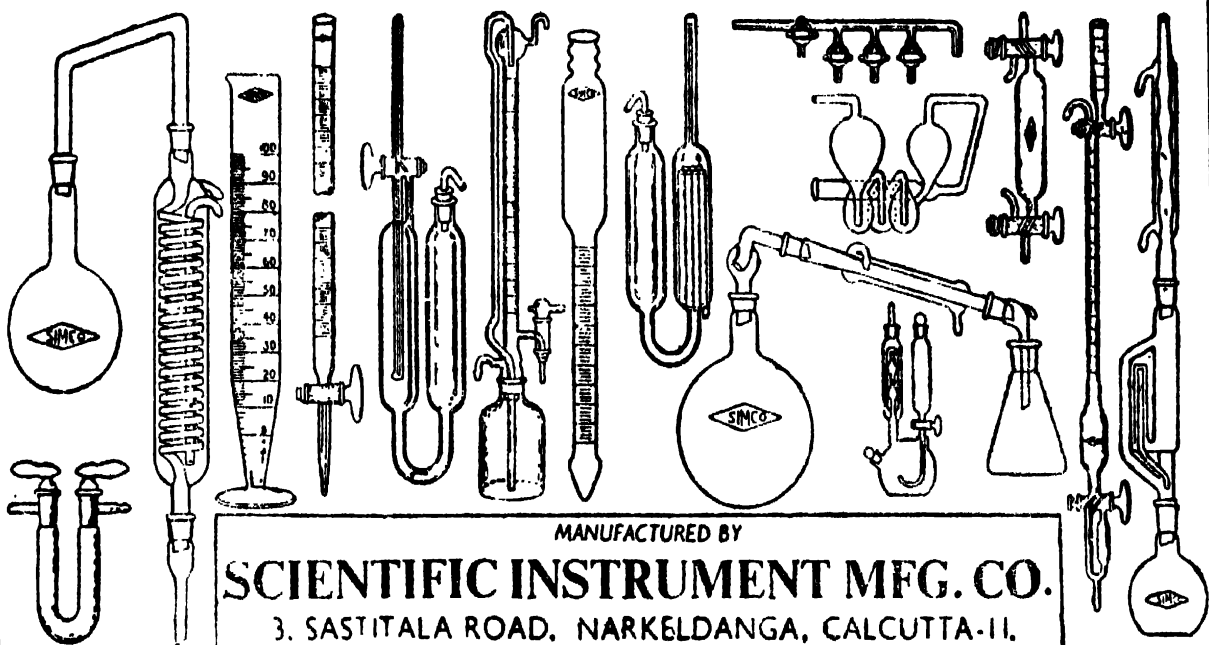
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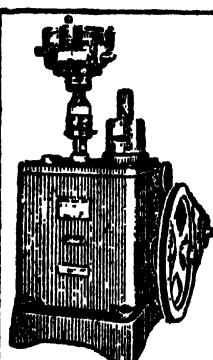
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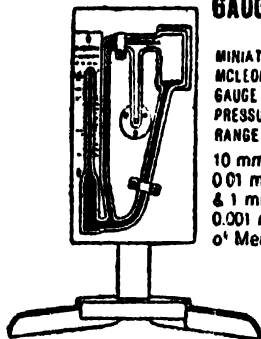
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SCIENCE & CULTURE

March 1987/Volume 53/Number 3

A MONTHLY JOURNAL OF NATURAL & CULTURAL SCIENCES

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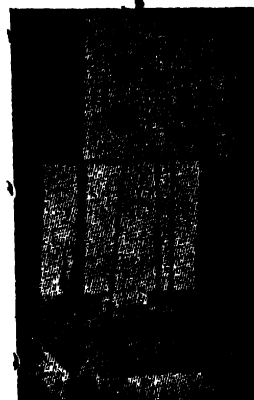
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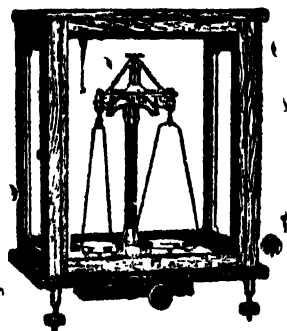


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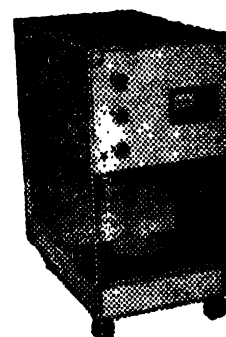
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ARE PROTONS DECAYING ?

PROTONS are the nuclei of the hydrogen atoms, Hydrogen being one of the main constituents of the living world, the question of proton decay appears as absurd as the question on the stability of ourselves. We have experiences of a number of naturally radioactive unstable elements ; we produce thousands of them artificially. In the same sense if we question on the stability of protons and if we want them to decay with a meanlife, our safety of being apparently stable will not matter much, if only the life time of proton decay is very very long. This does not save the situation, because to get a positive answer of the question 'Are the protons decaying?' We are to show how, a heavy particle can only decay to lighter ones. Neutrons, protons are heavy particles called Baryons. Lighter ones, called leptons, are electrons, positrons muons etc. Is it then possible for a proton to decay with an end product, positron and photon? The answer will be negative, since it breaks the conservation law, one of these laws is charge number conservation, which is not violated since proton and positron have the same charges. Other conservation law are baryon number and lepton number conservation in a reaction. The proposed decay mode of the proton fails to satisfy such conservation.

In 1929 Weyl and in 1949 Wigner formulated that electrons do not decay into neutrinos and photons and that by analogy,

protons do not decay. So comes the electron stability and charge number conservation Baryon number conservation is not founded on a concept of field as the electric field. So, the baryon conservation law is not based on a strong foothold. This was supported by the recent theories on unifying the forces of nature, electromagnetic, weak and strong forces. In unified theory neither baryon number nor lepton number, alone is conserved but rather a new quantum number called fermion number being the difference between the baryon and the lepton number is conserved in a reaction.

This fermion number has a role in the unified theory similar to that of charge number in the Maxwell's theory. Baryon numbers alone being not conserved, we can say 'yes' in reply to the question of proton decay. This is correct on principle, but does not fully assert how does it decay.

Recent theory of quarks suggests that protons, neutrons are not formless but are composed of pointlike fractionally charged particles called 'quarks'. A proton is composed of three such quarks ; two of them are up quarks and the third one is a down quark. Up and down are called flavours of the quarks with $+2/3$ and $-1/3$ fractional charge respectively. Two up and one down quark thus constitute one proton with unit charge number.

In 1973 Jogesh Pati and Abdus Salam postulated that three quarks of a proton

might be transformed into three leptons, of course a rare event. So rare that they calculated the life time of such decay to be as long as 10^{30} years.

In 1974 Georgi and Glashow, Georgi, Quinn and Weinberg proposed different modes of proton decay predicting proton life time as 10^{30} years. In their theory quarks interacting strongly inside the proton and leptons interacting via electromagnetism and radioactive decay were grouped together in a symmetry group. Its physical significance is that at very high energy, or at very short distances or at high temperature at the time of Bigbang when the universe was created, (all of which are equivalent) quarks and leptons belonged to the same family. Gradually the universe cooled down with manifestation of the particles with different masses interacting strongly, weakly or electro-magnetically. However, from their primordial relationship, their transition from one to another, though rare, is possible. Thus quarks can transform into leptons resulting in proton decay.

During the last few years theory and experiment succeeded in joining the electromagnetic and weak force to one electroweak force, mediated by a Boson Z^0 , the counter part of the photon in electromagnetism. Z^0 has mass of the order of 90 GeV. The proton antiproton beam collider at CERN could prove the existence of Z^0 recently. The grand unification of the strong force and the electroweak force is established by electronuclear theory, which requires heavy particles like X and Y bosons to mediate the interaction of the electronuclear theory. Masses of X and Y bosons are not within the reach of any existing accelerator. However such masses can exist in a reaction for a short time determined by the Heisenberg's uncertainty principle related with mass through, the Planck constant. Inside a proton, a down quark can transform into a positron and a up quark to an anti-up quark mediated through the heavy X or Y boson, emitted spontaneously. The third u quark of

the proton unites with the anti-up quark to form a π^0 meson. π^0 eventually decays into two photons. Proton thus may decay to a positron and photon violating baryon or lepton number conservation.

How heavy are the X and Y bosons? In recent experiments, it is observed that the strength of the strong, electromagnetic and weak interactions all change with energy. At the time of the big-bang at high energy or temperature of the universe, all the forces have the same strength. As the energy 10^{14} GeV the weak force becomes stronger as the electromagnetic force and the strong force becomes weaker for a grand unification. At this energy all the three forces were similar, which sets the mass of X and Y bosons to the equivalent energy involving the proton decay. That is why proton decay is so rare to observe. The longlife of proton remains difficult to observe in the human life time. Instead, one can try to observe one decay in 10^{30} atoms of hydrogen in a year. Such trial experiments are on the way to prove the proton decay of the above mode or by other possible modes. Nearly ten such experiments are in progress or under construction. The Irvine-Michigan-Brookhaven experiment uses water as source of proton in the underground Morton mine, similar 800 ton source is used by Harward Purdue Wisconsin collaboration at the Silverking Mine near Salt Lake city of USA. In the Kamioka metal mine near Tokyo another experiment with 3000 ton water is set up. Water is replaced by iron plates in some experiment. One such experiment at the depth of 2500 m in the Kolar gold mines in South India is in operation as a Japan-India collaboration programme, which uses 150 tons iron. At least three proton decay events are reported from the Kolar gold mines experiments so far. A similar experiment with 150 ton iron in the Mont Blanc at a depth of 1600 m reports one possible proton decay event since May 1982.

Thus the above underground experiments, which eliminate cosmic ray background,

mimicking proton decay products are assumed to be the experiments of the century to unveil the mystery of the universe.

Now one can ask 'why do we require protons to decay?' One answer is based on the unification theory of forces discussed before. A second answer lies, in solving the puzzle of a cosmological problem, that at present in the universe there are one billion photons for each proton or neutron.

In the big-bang model, the primordial universe was all energy. With cooling and expansion of the universe the energy condensed to equal parts of matter and antimatter, which again annihilate with each other to make light. Absence of equal amount of antimatter in the universe questions the above processes. The unifying theory by establishing violation of baryon conservation establishes the proton decay so that baryons and leptons belong to the same family. So, light plus a small excess of matter over

antimatter at the present universe is explained, since simple pair formation from energy and annihilation of the pairs further pass through a complicated process at high energy when baryons and leptons are not identifiable, separately.

In 1947 Sakharov rightly remarked that for our very existence with the small amount of matter over antimatter implies that protons must decay.

Still now decay of proton is not proved by the experimental results unequivocally. In January, 1986, Abdus Salam, a proponent of the electronuclear theory, remarked at Calcutta perhaps on earth proton decay experiment can not succeed, as the cosmic ray background will always mimic the proton decay product. Still then, the electronuclear theory has established this truth that protons decay and it ascertain the big-bang model of the universe. □

S. B. Karmohapatro

COMMUNITY BIO-GAS PLANT : AN EXPERIENCE OF A COMMUNITY PROJECT IN A VILLAGE OF GUJARAT

KARUNAMAY SUBUDDHI*

THE presence of natural gas was known and recorded in the ancient civilizations of China, Egypt and Rome. Allexandre Volta of Northern Italy was first person to associate the burning gas with decaying negotiation in the year 1776. The presence of Mathane in farmyard manure was detected by Mr. Humphrey Davey in the early 1800's. The first plant for obtaining Mathane from waste was set up in 1900 at Mutunga (India).

After first world war, production of Mathane was revived in Great Britain and later it speeded after second world war due to acute shortage caused by blockage of Nazi occupied areas. The process was

satisfactory as devised by French scientists in North Africa in 1940 and it evoked good response in Austria, Italy, Russia, Kenya, Uganda and South Africa.

Introduction of Gobar Gas Plant in India was set up in 1900. In 1939, Mr. S. V. Desai, Indian Agricultural Research Institute (IARI) has designed and built first cattle dung digester and studied the nature of the cattle dung digestion process. The first breakthrough in the manufacturing of practical plant was made available by Shri Jashbhai Patel who patented this plant 'Gramlaxmi' in 1951.

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The successful appearance of Gramlaxmi Plant renewed the interest and activity in Gobar Gas work. The research work was continued by the scientists of the AIRI and some individuals notably 'Swami Vishwa-Karmanand' of Balurmath and Shri S. C. Das Gupta of Khadi Pratisthan, Calcutta.

The Gramlaxmi Gas Plant underwent substantial modifications and in 1959 the

necessary additional finance by way of subsidy for the direct cost of the plant. Target set by Gujarat Government in this regard as follows :

Establishment of 33,000 Gobar Gas plants are targeted during remaining Sixth Plan Period (3 years) yearwise and model-wise break up of the target is given in table 1.

TABLE 1.

Period	No. of fix dome type plants	No. of KVIC model plant	Total No. of plants	No. of plants to be connected with Latrines
1982-83	3,700	3,000	6,700	1,600
1983-84	6,800	3,500	10,300	2,500
1984-85	12,000	4,000	16,000	4,000
Total :	22,500	10,500	33,000	8,000

improved design was adopted by Khadi and Village Industries Commission (KVIC). The KVIC since then has been popularising use of Gobar Gas Plant through nation-wide programme.

Gujarat state has been a pioneer in the country by setting up of about 100 Gobar Gas Plants in Saurashtra in the year 1955-56 and till end of 1974, Gujarat has maintained lead by establishing 3000 plants out of total of 7000 plants set up in the country till then. These after Haryana has taken lead by setting up 12,000 plants in two years. Punjab, U.P. and Maharashtra also accelerated the progress. By now, there are more than 1,00,000 Gobar Gas plants in the country. Out of which about 80,000 plants are set up during last six years. There are about 13,6000 plants in Gujarat and but for about 1000 plants, rest are functioning, normally. Out of these plants, 4000 plants are connected with Latrines.

The Government of Gujarat has not only adopted and approved the national project as labelled by the Government of India and is further supported by with

Importance of Gobar Gas Plants

The present acute energy crisis due to experience with rural electrification, the recent oil crisis and shortage of firewood/ Coal has diverted the attention towards the need of locally available resources. In this context, the Installation of Gobar Gas Plants for the purposes on a large scale was considered necessary and important. The Government of India repeatedly set a target of installation of one lakh plants during the fifth five year plan and in sixth five year plan its target increased to the tune of four lakhs of bio-gas units. It was also stressed and gave much importance in the new twenty-point programme.

India has largest cattle population of 226 million (1961 live-stock census) and has an enormous potential for energy. Increasing dung through gas plants can thus provide an alternative source of fuel and fertilizer for the use of rural population which constitute a lions share. Thereby channelizing dungs through Gobar Gas Plants, we can achieve following different benefits and advantages :

- (1) more and better fuel
- (2) more and richer manure
- (3) we eliminate environmental pollution
- (4) solve the fertilizer problem
- (5) prevent deforestation
- (6) improve health of whole family
- (7) improve economic condition by providing more leisure for part time employment, saving doctor's bill and increasing life of utensils
- (8) add to the aesthetic appearance of the house and surroundings with brighter wells and neat clean yards.

Need for Community Gobar Gas Plants

Small farmers are always deprived of the fruits of modernisations mainly due to lack of resources and economical utilisation of modern equipment. Similarly in case of installing individual Gobar Gas Plants, small farmers do not have :

- (i) enough number of cattle
- (ii) capital resources
- (iii) awareness of tangible and intangible benefits
- (iv) suitable place to instal Gobar Gas Plant.

The introduction of community Gobar Gas Plants has certainly overcome all above problems with additional advantage of generating gas at very low cost due to distribution of overheads. In villages where villagers have continuous row of houses, cannot instal Gobar Gas Plants in each house due to lack of sufficient and suitable place/space. Apart from other factors, like capital, availability of required quantity of dung, economical operation plants etc. So, the villagers can come together and instal a big plant at suitable site. Where collection of dung can be made easily and the clurry can be disposed off conveniently. It is easier to manage the subsidies available from Central, State and KVIC and bank loans for installation of such community bio-gas plant.

Background : General

The Gujarat Diary Development Corporation Ltd. has initiated the community bio-gas plant at the village Khoraj. The selection of this village Khoraj in Gandhinagar district could be traced back to the cooperation among the villagers. This can be easily seen that since 20 years the Gram Panchayat election never held and Sarpanch is elected unanimously. This village stands first in Gandhinagar District when Zilla Panchayat's performance on developmental programmes are taken into account. The village is economically well off. There are 1,800 acres of land, out of which 1,500 acres is cultivated land and 300 acres is grazing land. About 54% of cultivated land is irrigated land and farmers produces crops like cotton, wheat, barley, tomato, mustard and also lucerns (Rajuka) fodder. In unirrigated land, they cultivate jowar, cotton and castor. The village has electricity. It is mostly constituted of Patels and Rabaris. Rabaris are economically poorer and they attach more towards their cattle. This village has a great numbers of cellars who are tenants and travels up down to Ahmedabad for factory works. It is well connected with railways and it has frequent train schedules to Ahmedabad-Kalol-Mehsana line. People's occupation revolves primarily to Agriculture, factory workers and milk supply to city.

Objectives of the Study

The present study attempts to study the following aspects of community bio-gas plant in Khoraj village :

- (1) To understand the operating conditions of the existing community bio-gas plants in a village.
- (2) To look out the economies of scale and to find alternatives.
- (3) To examine the organizational structure and people's participation.

Scope of the Study

The scope of this study is limited to the working out economies of scale and finding alternatives and forwarding some recommendations for the effective, economic and manageable community bio-gas plant at Khoraj. It has a wide scope, in terms of its applicability to other villages of similar socio-economic characteristics.

Methodology

Methodology adopted is an exploratory in nature. For that we met the organization and its officials who are directly involved in this plant. We also visited the village with employees of GDDC and also a resident of the same village and availing gas connection. We interviewed few household about the prices which they sell Gobar and buy gas from the plant. We met concerned village sarpanch and influential people of the village. On the second visit, we made a checklist and unstructured queries about the affordability and the problems of management with gas plant. We met different walks of people for interviewing and especially women folks who is directly linked with cooking gas provisions. Given time constraint, we have attempted to go in depth and tried to bring out a useful and detail report.

An Overview of Experience

Out of the major reasons for the establishment of the Community Bio-Gas Plant in village Khoraj (District Gandhinagar) was the potential demand for the same. In fact the techno-economic feasibility study carried out by the Gujarat Agro-Industries Corporation brought out this fact very explicitly. It was estimated that the village will be covered by community Bio-gas Plant in two stages. According to the plans, the first segment of 112 families were to get the benefit at the first stage (which was estimated on the dung availability in these households). About 3800 kgs of dung per

day was expected from these beneficiary families, and the total gas supplied was to be for a period of nine hours per day at the cost of Rs. 9 per adult member, per month.

When the plant was actually installed, and it started operating, only 38 families had opted for individual gas connections, and the total gobar supplied was 2301 kg of which the beneficiary families supplied a very minimal quantum. The prime reasons for the lack of acceptability and which explained the partial failure of the Community Bio-Gas Plant to make an impact in the village system by bringing within its fold more and more beneficiaries, can be summed up as follows :

- (1) The techno-economic feasibility survey favoured for the establishment of the plant on the basis of the promise that the dung supplied per day would be to the tune of 3800 kg ; (to be met with by the 112 beneficiary families), but in actuality the total supply of dung was only 2058 kg per day, and most of which was supplied by the non-beneficiary families.

Such a phenomenon, not only explain the (a) shortage in the supply of estimated quantum of dung (1742 kg per day, or 45.8% deficit) and (b) also reflect upon the lack of commitment on the part of beneficiary families to positively participate in such a programme,—the reasons for this could be many and will be dealt with in the later section.

Shortage in the supply of dung triggered of a dangerous process which is nothing short of a vicious circle. As a result of this, the gas production has substantially reduced (by about 45.8%). The situation of the gas production would have been far more worst, had the Rabari community not come to rescue by providing about 63% of the total dung supplied per

day. Shortage in gas supply has forced the GDDC who presently are operating the plant, to not only reduce the number of hours from nine hours as promised earlier, to only about five hours at present, but also hesitation increasing the number of beneficiaries—a step which would have yielded profits as a result of increasing the scale of operation. The shortage in the supply of dung was explained (i) by the cost factor associated with it, as also (ii) by the rooted traditions of the Patel community (which was also the beneficiary group).

The cost factors as worked out by the crude economic logic of the Rabaris (and also some of the Patel community members) revealed that selling of dung to the plant at 0.05 ps per kg was much less than what the same quantity could have fetched in the form of dung cakes (0.60 ps to 0.75 ps) and which was actually being sold to either the brick-kiln factory at about 1½ km distance from the village, or to the poorer households. In fact the dung cakes continue to be the major source of fuel mainly because of its relative cheapness (per person cost energy requirement in the form of gas, per day is 0.30 ps whereas the cost incurred by the use of dung cakes is only 0.20 ps per day).

Non-acceptance of Bio-gas as an alternate energy source is probably explained by the fact that there is no genuine need for the same as the conventional sources continue to be cheaper than the alternative source of Biogas. In fact most of the rural energy requirement of people are met by the wood and dry grass from the agricultural fields or open areas around the village, and also by the dung cakes—energy from these sources is mostly free of cost as they are the by-products and in those cases where

the households use dung cakes the price is relatively less than that of Bio-gas. Energy from such conventional sources become all the more economical in the case of families which have relatively more members (e.g. Rabari families).

Reasons for the lack of commitment on the part of the beneficiary groups can be traced back to their traditions. Similarly, cultural factors have also determined the non-acceptability of bio-gas in the Rabari communities, despite the fact that a main pipeline was laid down in their neighbourhood. Most of such households considered the supplying of dung to the plant, in person (which meant cleaning the dung and carrying it to the plant in the early hours of morning) as an act not compatible to their cultural norms, whereas some families found it problematic. They suggested that the dung should be collected from door to door by the concerned person(s).

- (2) Due to the shortage in the production of gas, the total supply time is only about five hours. The timings has been such synchronised that the gas is not put to effective energy use. In the morning the gas is released from the storage tank for 2½ hours from 6 a.m. to 7 p.m. During such odd timings since the households are unable to perform energy-based kitchen activities (primarily cooking), as a result they feel that their paying for the gas is more a waste, as they continue to depend on the conventional energy sources; and hence in no way better-off by getting the bio-gas connection. Most families during interviews suggested that the gas should be supplied for a minimum of eight hours—the timings to be such allotted that effective use of the same can be made (5.00 a.m. to 8 a.m.) (11 a.m. to 1 p.m.; 5 p.m. to 8 p.m.)

- (3) Non-acceptability of biogas is also because of the fact that about half (200 families) of the families in the village reside in rented houses, and hence it become impossible to invest in getting the individual gas connection, laying of pipes etc. as there is no permanency in residence. Apart from this, the initial investment itself is so high varying from Rs. 900 to Rs. 1200 (inclusive of cost of store, laying of pipes and advance payment) that potential beneficiaries shy away from getting the connections.

Need for bio-gas as an alternative fuel was not really felt that strongly at the aggregate village level—which could probably be explained by the availability of 25 LPG connections (10 of which came after the bio-gas plant was operationalised). Most of the L.P.G. house-holds are also the ones which are more influential in the village (e.g. the Sarpanch), and are not having bio-gas connections. As a result, failure on the part of the general households to apply for such gas connections can be explained (absence of "reference group" opinion leaders).

Alternative Scenarios

The observations we made have increased our interest to go indepth about the problems that mentioned in previous chapter. Broadly problems that encountered were classified into three categories :

- (1) Absence of break-even point in the present operating conditions of Community Bio-gas Plant.
- (2) Unstructured organisation to manage the plant.
- (3) Lack of People's participation.

All these problems were both felt problems of users and non-users, and on the other side observed problems etc. also. To make it more specific, we began with two

level fact finding process. In our first visit, we had detailed discussions with GDDC officials and incharge persons of the plant and Sarpanch of the village. And later user families and potential suppliers were approached with unstructured checklist in informal manner. Here emphasis was maintained to collect information basically from women as they have continuous touch with both performance and problems of this Gobar Gas for cooking.

Break-even point

As most of the households complained about inadequate supply of gas, the potential suppliers of dung (i.e. Rabaria supplying 63%) are essentially seek highest price per kg of dung to increase the supply and to keep the persistent supply.

But the picture in existing reality is different what people perceiving. The feasibility Report suggested to pay 0.02/kg of dung. As in practice the expected quantity of supply (3800 kg/day) fall of expectations in early stages itself, the price was increased to 0.04 paise/kg. When supply still remained to only 2301 kg/day, after five months of deliberations with supplying families, it was increased to 0.05 paise/kg. In spite of 50 kg's increased in supply per day, in average not much change has taken place to increase the production of gas or for that case to have a stability in supply.

One aspect has made it clear that installation of gas meters at household level is prime necessity as presently a family (depend upon the members above 12 years) has to pay Rs./person/p.m. i.e. Rs. 45/p.m. in case of four members in a family. As one can't ruled out the high installation cost of Gas meters on part of the families in longer term it helps both organisation and as well as families also.

In this regard different supply rates has tried hypothetically to reach a break-even point. Where plant can operate on no

profit—no loss basis instead of present mounting loss conditions. So, finally it appears here that organisation can increase the Dung price to 0.06 ps/kg and thereby expecting another 250 kg/day will suffice for the 103 households, keeping the standard of 27.18 cmt/per family (of four members) per day.

Here, it is important to know other conditions of operation also.

- (a) Installation of Gas meters helpful only to the certain extent (i.e. when 0.04 ps/kg and supply is 2301 kg/day).
- (b) Behind these limits as the price for supply of Dung increases collection of money should also increase, where that rate is normally practiced to claim over the loss
- (c) But again it shows next to impossible to pay 0.07 paise/kg if the supply of cow dung remain to 2551 kgs which will result in Rs. 22.30 loss per day.

So, it is suggested that given the present conditions, as on the one side suppliers demanding more price it can be increased to 0.06 ps/kg and by convincing the extra 250 kg/day can also have persisted supply of 9 hours per day from present 5-6 hours per day.

Organisation and People's Participation

Local people participation in Community Development activities has emphasised in all spatial as well as target approached schemes for its successful implementation, which is the major inadequacy in this project is almost insignificant level. It is not there neither at the installation level nor at present operating level.

Hence, it is necessitated at the outset, local opinion leaders group should be formulate to take incharge for the smooth operation of the plant, while major decision making authority can be hold by GDDC. However, it doesn't mean that suggestions made by local group should not take into consideration.

By experience in different corners of the country it is realised that basically motivating the housewives is very essential, in this technology-oriented new positive alternatives in practice, as they are the real persons in touch with these things. Frequent audio-visual shows and demonstrations explaining various uses of gobar-gas and importance in the present context, will act as influential factors to accept and to participate in the activity.

This research project was conducted by the author with the help of three Post-Graduate planning students (Mr. Sushil Kr. Pant, Mr. T. Tering and Mr. Vengam Raju) who were associated with School of Planning, Ahmedabad. □

THE PRINCIPIA : A LANDMARK IN HUMAN CIVILIZATION

V. V. RAMAN*

WARS are waged and won ; conflicts come and go ; kingdoms rise and fall ; treaties are signed and broken ; cities are built and destroyed ; though these are the kinds of events that crowd the pages of history books, the torch of human civilization is carried by great works of art and culture, and new directions for the human spirit are forged by the creativity of the great minds of the human race.

One such mind of unsurpassed scientific genius belonged to Isaac Newton (1642-1727), and one such work bore the imposing title of *Philosophiae Naturalis Principia Naturalis*. This great book, a major landmark in the history of human thought, was first published in 1687. This year thus marks the 300th anniversary of its birth. Scholars commemorate the event in various conferences and symposia in many centers all over the world, and through articles in numerous journals. It is appropriate that a journal devoted to science and culture also take note of the tricentennial of the Principia.

Brief Note on Newton

Newton was born in Woolsthorpe on a day that corresponded to December 25, 1642 of the Julian calendar that was then in vogue in England. (This was the same as January 4, 1643 according to the Gregorian calendar that we now follow). His father had died before his birth, and young Isaac was first left to the care of his grandparents. When yet a youngster he was once taken away from school to assist his mother in the farm. But an uncle of his recognized the youth's intellectual potential and sent him to the University at Cambridge from where he graduated in 1665 with the highest honors.

When the famous plague ravaged London, Newton retired to the farm in 1666. It was there that he discovered his binomial theorem, developed the germinal ideas of the calculus, and did some significant experiments on light. In 1667 Newton came back to Cambridge where he was to spend the next three decades of his life. At the age of 27 he was made Lucasian Professor of Mathematics, which was no mean honor. Only three years later, he was elected Fellow of the Royal Society.

For many years Newton was perennially engrossed in a variety of intellectual endeavors that ranged from mathematics to optics, from astronomy to cosmogony, and from alchemy to theology. He was prodigious in his output and tireless in his efforts, but he was also reserved if not secretive, reflective to the point of being absent-minded, and extremely touchy about criticism. He seems to have had little interest in or longing for female company.

Newton had his share of quarrels and misunderstandings with his contemporaries ; he experienced a nervous breakdown which sent him to two years of retirement ; he became not only president of the Royal Society, but also Master of the Mint. He was, in short, very much a human being, but one that has left a legacy that will forever be counted among the grand heritage of humankind.

The Philosophical Context the Principia

During the second half of the 17th century, the scientific investigators of Europe had arrived at a number of conclusions in the context of their efforts to

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understand and interpret the world of phenomena. These included such items as : the need for careful observations and experimentations before attempting to explain any aspect of the world ; the importance of quantitative methods in any scientific analysis of a physical phenomenon ; and the primacy of motion in all natural processes.

Such ideas were related to the mechanical philosophy of the time which held the view that the world is not quite what it seems to the naked eye, and that in order to fully explain its myriad facets we need to imagine not-directly perceptible entities as the root causes of all that is apparent at our scale of experience. It was held that by imagining such entities we should be able to explain everything that is happening in the world.

Strange as it may sound, Newton himself did not subscribe to this central thesis of the mechanical philosophy. On the other hand, he was convinced that the human mind could never grasp the ultimate essence of things. Like Descartes who described the entire phenomenal world with the simple phrase, *matter in motion*, Newton recognized the importance of motion in all natural phenomena. Indeed, in his view, the ultimate goal of physics was "an exact description of the phenomena of motion in quantitative terms".

The Scientific Context of the Principia

Prior to the publication of the *Principia*, many concepts had been developed, many observations had been made, and many results had been obtained on the nature of matter and motion. Thus the law of inertia had been formulated, detailed astronomical data had been gathered on planetary orbits, and Kepler's laws of planetary motion had been enunciated. But there was as yet no systematic presentation of all of this, no broad principles to embrace the variety

of phenomena in a global perspective. What is more, there was still the lingering Aristotelian belief that terrestrial laws were different from celestial. The motion of the moon had nothing in common with that of a terrestrial projectile.

Nor had one yet explained successfully a number of well studied phenomena, such as the elliptic paths of planets around the sun. This was the state of affairs when Newton's work appeared.

The Circumstances Leading to the Principia

In 1684 Edmund Halley paid a visit to Newton at Cambridge, during which he asked Newton what type of curve a planetary orbit would be if the force of attraction between the sun and the planet were of the inverse-square type. Newton is said to have answered without a moment's hesitation that it would be an ellipse. The mathematician De Moivre, who reported the incident for posterity, noted, "...the Doctor struck with joy & amazement, asked how he knew it...Why, saith he, I have calculated it."

Upon Halley's request, Newton sent to him later that year a nine-page treatise entitled, *De motu corporum in gyrum (On the Motion of Bodies in Orbit)*. In this work it was proved that elliptical orbits implied an inverse-square law type of force, and that an inverse square force implied an orbit that was a conic section. Halley was so much impressed by the slender volume that he went to Cambridge to plead with Newton to compose a longer treatise on the subject.

From now on, until the spring of 1686 Newton's time and energy were concentrated on the writing of the *Principia*. Apparently he used to deliver some of its contents as lectures to the few students who cared to sit through the master's presentation of the incomprehensible ideas.

The Principia

The magnum opus appeared in July 1687, when Newton was 44 years old, as a single volume comprising some 500 pages. The work was in Latin so that it could be accessible to all scientific investigators in Europe. The 2500 copies of the book were sold at nine shillings a copy.

The work, which consists of three Books, begins with a number of definitions and axioms which give precise meanings to such fundamental concepts as force, momentum, and mass. Then the three laws of motion are stated.

Book I deals with what we now call rational mechanics. It lays the mathematical foundations of celestial mechanics in which planetary bodies are treated as point masses, a tremendous intellectual leap indeed! The theorems are given in terse formulations, somewhat like the *sutras* of Sanskrit treatises. The implications of these succinct statements are explored in corollaries and further discussions, including experimental results. These are referred to as *scholia*.

It was in Book I of the Principia that Newton first published the principles of the calculus which he had developed. Yet many of the results obtained in the work are based on geometrical reasoning, as was the custom in those days.

The three-body problem (sun, planet and a satellite) is explored here, as well as non-closed orbits (such as the moon's). Here we find a proof of the theorem that the gravitation of a spherical body is the same as if all its mass were concentrated at the center. There are considerations of gravitation due to non-spherical mass-distributions. Finally, there is even a statement to the effect that light corpuscles will be deflected in a strong gravitational field!

The second book discusses motion in a resistive medium. Fluid mechanics is considered in this context. There is also a discussion of the motion of a pendulum,

taking air resistance into account. The velocity of sound in air is examined both theoretically and from an experimental perspective. Newton also shows the untenability of Cartesian vortices (a then very popular notion in explaining planetary motions, at least qualitatively).

Book III is entitled *De Mundi Systemate* (*The System of the World*). This is sometimes regarded as "the heart of the Principia". Here, for the first time, we read the bold statement that "Like effects in nature are produced by like causes, as breathing in man and in beast, the fall of stones in Europe and in America, the light of the kitchen fire and of the sun, the reflection of light on the earth and on the planets". So obviously true, it might sound to us of the 20th century; but a revolutionary vision for 17th century minds. To assume a uniformity of physical laws and processes on earth as in the heavens was a sweeping perspective that transformed the entire universe into a sporting ground for the scientific intellect. In this Book is also to be found the grand generalization of gravitation, the first of the unified field theories that saw in the fall of the apple and the motion of the moon the self-same principle in operation.

Here again Newton discusses the moon's librations, the flattening of the earth at the poles, tides and gyroscopic motion, as also the appearance and disappearance of comets.

These are among the momentous themes brought within the covers of the *Principia*. Scholars and commentators have praised and appraised this remarkable work in myriad ways and pages. Its extraordinary blending of mathematics and physics and its subtle handling of the force concept which is central to the whole work made it the framework for physics for next two centuries. No other declaration of the human mind, no other statement uttered in human terms has been more all-embracing, more fruitful or more insightful than

Newton's laws of motion. The influence of force on motion explains all the chaotic multiplicity in the world.

Acceptance

It has been said that hardly three or four of Newton's contemporaries fully understood the *Principia*, a fate that was to befall Einstein's theory of gravitation as well. Within about three years after its publication, the classic masterpiece became required material for study in at least some English and Scottish universities. It may be pointed out that though much of its contents has become elementary scientific knowledge, not many with even a Ph.D. in physics can plough through the work today.

However, it took much longer for the Newtonian ideas to be spread, let alone accepted in European centers of learning and beyond. Newton's name was already known in Continental scientific circles, largely due to his work on light and color, and to his invention of the reflecting telescope. Interestingly enough, he was known as a gifted mathematician, not from any of his publications, but through a reputation that travelled through word of mouth. Leibnitz and Huygens, perhaps the only minds who could fathom the insights of the work, while recognizing the merits of the *Principia*, had deep reservations about many matters in it. Fontenelle, the secretary of the French Academy of Sciences, himself a staunch Cartesian, did not give in to the Newtonian world view. A small group of French philosophers (followers of Malebranche) were the first in Europe to be converted to Newtonianism. But it was much later, thanks largely to the populari-

zations of Voltaire and the championing of the work by Clairault and Maupertuis that the *Principia* was eventually accepted in France and in the rest of Europe.

Newtonian Scholarship

There is a wealth of Newtonian scholarship. Much of it has grown during the past three decades, inspired largely from I. B. Cohen's classic study on *Franklin and Newton* (1956). Alexandre Koyrès *Newtonian Studies* is a scholarly collection on a variety of themes related to Newton. A publication in 1970, entitled *The Annus Mirabilis of Sir Isaac Newton*, contains a number of original papers on the then current historical research on various aspects of Newton's work. The *Archive for History of Exact Sciences*, *Archives internationales d'histoires des sciences*, as well as *Annals of Science* contain a number of papers on Newton's *Principia*. Specifically, A. R. Hall and M. B. Hall, J. Herivel, R. S. Westfall, I. B. Cohen, and D. T. Whiteside are among the current eminent Newtonian scholars who have written on various aspects of the *Principia*.

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OBITUARY

G. THANIKAIMONI (1938-1986)

It was probably the cruel destiny that snatched G. Thanikaimoni, a name to be reckoned with in the palynological world, away from us on September 5, 1986 during the prime of his brilliant scientific career. This is all the more tragic because the death came as a result of a ruthless and senseless terroristic onslaught on innocent people. Thanikaimoni was on his way to



G. THANIKAIMONI

the United States to attend the Second International Conference on Palaeo-Oceanography at Woodshole, Mass. The aircraft in which he was travelling, was hijacked in Karachi on the same day.

Thanikaimoni was born on January 1, 1938. After his M.Sc. in Botany from the University of Madras, he joined the French Institute at Pondicherry in 1962 where his research career started. He was ushered to the discipline of Palynology by Ph. Guinet and in 1963 he took over the charge of the Palynology Laboratory of the Institute. He worked extensively on the pollen morphology and systematics of the Palmae, the results of which were embodied in the

form of a thesis and submitted to the University of Montpellier (France) in 1970, on the basis of which he received the award of the degree of Doctor of Science (Doctorat d'Etat). The thesis contained original ideas on the pollen morphology, taxonomy and phylogeny of the palms with a global distribution and was later published under the auspices of the French Institute. Besides the palms, he also worked on the tropical plant families like Araceae, Eriocaulaceae, Lentibulariaceae, Menispermaceae, Potamogetonaceae, Sonneratiaceae, etc, not only palynologically but also in terms of phyto-geographic distribution and evolution. Many promising young palynologists received training in his laboratory among whom G. Vasanthi and Y. N. Seetharam got their Ph.D. degree under his supervision.

Apart from pollen morphology in relation to taxonomy, Thanikaimoni also made a significant contribution to the understanding of Guaternary pollen analysis in terms of vegetational history of the hills of South India with F. Blasco of the University of Toulouse, and on the mangroves with C. Caratini and C. Tissot of the University of Bordeaux. He, at a later stage, also had the privilege of working on the pollen analysis of some archaeological sites of Indonesia, Kampuchea and Thailand. The author of this obituary note had the privilege of working with G. Thanikaimoni on some ultrastructural aspect of pollen apertures and also making field trips to the Sunderbans to explore the eco-physiology and distribution of the mangrove vegetation.

Thanikaimoni developed active palynological collaborations with many specialists in India and abroad. Of particular interest to him were the problems of intricate pollen morphological terminology. This interest made him a member of the International Working Group on the Palynological Terminology. The Linnean Society of London invited him in 1983 to present his findings

on the form and function of diverse pollen apertures.

Thanikaimoni was also greatly interested on the occurrence and distribution of pollen grains of Tertiary sediments. Jointly with C. Caratini of the University of Bordeaux, he organised a workshop on this subject in Pondicherry in April, 1983 which was attended by many experts from India and abroad. This was especially significant because the applied aspect of oil-bearing strata belong to the Tertiary.

The reference-pollen collection of the French Institute consisting of over 20,000 slides of living species was carefully organised by him. The palynological collection of this Institute became very rich due to his persistent efforts. This valuable collection of scientific literature has been consulted by many scientists from India and abroad.

Thanikaimoni served the Birbal Sahni

Institute of Palaeobotany, Lucknow, as a member of its Scientific Advisory Committee. His monumental contribution in the form of five volumes of Bibliographic Index of the Morphology of Pollen Grains of Angiosperms is considered as an extremely useful treatise for those who deal with extant pollen morphforms. The compilation of this valuable work began in 1972, till date covering 9,000 genera and over 5,300 publications from all over the world. His sincerity and dedication brought the Palynological Laboratory of the French Institute to the limelight of world palynology. He had published about 50 research papers and some books which leave a testimony of his scientific excellence.

Thanikaimoni has left behind his wife, a son and a daughter besides numerous friends and fellow-scientists in India and abroad who profoundly mourn his premature death. □

Sunirmal Chanda

NOTES & NEWS

New IAEA programme for radioactivity measurements

A new programme to provide national and international authorities with reliable and comparable data in cases of radioactive fallout has been started at the IAEA. Part of the Agency's efforts to strengthen its nuclear safety activities, the programme is an outcome of lessons learned following the nuclear plant accident at Chernobyl in April 1986, when countries made requests to IAEA for assistance in radioactivity measurements and radiochemical analysis of food and environmental samples. The experience taught that there were urgent needs for laboratories capable of handling large numbers of samples, and for a document of

reference methods for use in radioactivity measurements.

At a consultants' meeting in December at the IAEA, participants from Austria, Finland, France, India, Italy, Poland, and the United States joined Agency experts in reviewing a comprehensive draft document elaborating on the programme, which is being supported and co ordinated by the IAEA Laboratories at Seibersdorf, Austria.

General aims of the programme are to :

- Provide a set of reference methods for measuring key radionuclides in environmental samples and foodstuffs
- Organize intercomparison runs to assure the quality of radioactivity measurements and to provide radionuclide reference materials for testing radioanalytical methods and for calibrating measuring equipment

● Assist IAEA developing Member States in setting up environmental monitoring laboratories for measuring fallout radioactivity in food and the environment

● Provide training programmes.

Plans are to publish a guidebook on reference methods for the determination of key radionuclides in basic foodstuffs and environmental samples, with emphasis on accidental situations and background radioactivity monitoring. The work will serve as a valuable update, since technical advances in this field over recent years have simplified certain procedures and improved the reliability of radioactivity measurements. □

IAEA Newsbriefs

Isotopes in medicine : Studying human nutrition and health

Concern about radiation doses sometimes limits the use of radioisotopes as tracers in human nutritional and medical studies, even though only a very small dose is involved. In many advanced countries, attention has been shifting to the possible application of *stable* isotopes, which are inherently so safe that they can be used even in studies of infants, children, and pregnant or lactating women.

As part of work in this field, the IAEA is planning a new co-ordinated research programme, which is due to start in 1987, on applications of stable isotopes in studies of human nutrition and nutritionally-related diseases. This is expected to focus on measurements of protein turnover and energy expenditure in selected population groups, mainly in developing countries. It is also anticipated that the Agency may be able to provide support for work of this kind through technical co-operation projects and fellowship training.

The research programme was an important topic at a recent IAEA seminar in Vienna,

attended by about 25 participants from 18 countries, mostly from Africa, Asia, and the Pacific. Although techniques using stable isotopes are at an early stage of application in most developing countries, they have been in use for several years in some developed ones. The main stable isotopes of interest are deuterium (an isotope of hydrogen), carbon-13, nitrogen-15 and oxygen-18. Important information can be gained by the use of chemical compounds (water, proteins, or fat, for example) labelled with these isotopes. Current applications, which were discussed in detail during the meeting, include measurements of energy expenditure, body composition, and the metabolism of protein, fat, carbohydrates, and other nutrients in normal subjects. The same isotopes and compounds also find application in diagnostic and therapeutic studies relating to malnutrition, malabsorption syndromes, cirrhosis, and a variety of other diseases. Also discussed were topics related to the preparation of labelled compounds and developments in isotope measurement methods using techniques such as mass spectrometry, emission spectrometry and nuclear magnetic resonance, which rely on detecting small differences in the mass of the nucleus or its spin. □

IAEA Newsbriefs

Conveyor to provide vital mine-plant link at new Orissa alumina complex

National Aluminium Co. (NALCO) alumina complex at Damonjodi, Orissa, has recently installed the single curved conveyor belt system supplied by Cable Belt Ltd., U. K., for transporting bauxite from mine to process plant. It involves a curved conveyor route 14.6 km long which transports bauxite along the mine plateau at Panchpatmali, then falling sharply 340 metres, before reaching the Damonjodi plant. To minimise environmental

impact and civil works, a route involving 11 horizontal curves was chosen with radii as low as 2,000 metres. This spectacular cable belt conveyor route winds through the rural countryside over eight bridges and is the longest curved conveyor in Asia. With the Cable Belt belt positively located on the drive cables, the belt cannot move side-ways under fluctuating loads, thus ensuring maximum life under these arduous conditions of service.

The conveyor is designed to carry between 600 and 1,800 t.p.h., dependent on mine production. To vary the tonnage whilst still maintaining a full conveyor belt and to maximise system efficiency, a variable speed motor is fitted to optimise the conveyor speed. The 2,000 kw synchronous motors and reduction drive unit at the loading end of the conveyor provide this control when the conveyor is in positive and regenerative drive modes.

The bauxite is carried on 1,050-mm-wide general-purpose Cable Belt belting. As with all Cable Belt conveyors, the belt only carries the material, and in this instance drive tensions are transmitted by two 51-mm-drive cables. □

British Information Services

Technologies to boost edible oil production

CFTRI technologies for processing of sunflower seeds, mustard seed and rice bran, to obtain higher yields and better quality oil, were demonstrated at commercial mills in Mysore and Tumkur and also at the Institute on 23-24 October 1986. The demonstration was conducted by the CSIR Oilseed Technology Cell, which is associated with the National Technology Mission on Oilseeds Production. R & D work on upgrading oilseed processing technology is part of the national endeavour to achieve self-sufficiency in edible oils, thus eliminating the massive

outflow of foreign exchange for their import and attain self-sufficiency before the year 2000.

Dehulling of the seeds before oil extraction is an important step in the processing of sunflower and mustard seeds.

The process for recovery of oil from sunflower seeds—a newly emerging oilseed crop in India—was demonstrated at the Saraswathi Oil Mills, Mysore. The main features of the process are : higher recovery of oil, lesser wear and tear of the expeller screws, increased expeller capacity and a significantly lower power consumption. The oil obtained from dehulled seeds is low in free fatty acids and wax, and is much superior to the traditionally processed oil. It has an attractive bright yellow colour and a pleasant flavour

Extraction of good quality oil of desirable colour, flavour and pungency from mustard seeds was demonstrated at the CFTRI pilot plant using traditional expeller/power ghani. The cake, the byproduct of oil extraction, is free from anti-nutritional factors and bitterness, and the bland, high protein concentrate obtained from the cake is comparable nutritionally to the protein in milk and can be utilized in various proteinrich food supplements.

The process for producing edible oil from rice bran is based on the simple acid stabilisation of the bran to inactivate the fat splitting enzyme—lipase. Unless inactivated, this powerful enzyme can act on the oil and produce high amount of free fatty acids, which renders the oil unsuitable for edible uses. This technique was demonstrated at the Shankar Industries, Mysore, and Siddaganga Oil Mills, Tumkur. □

CFTRI Newsletter

National award in plant protection

Plant protection or pest management plays an important role in crop production.

It is estimated that 20-50 percent crop yields can be lost and in some cases, the entire crop can be lost, if insects, diseases, weeds, rodents and other pests are not controlled in time. Therefore, plant protection or pest management has become an essential and integral part of agricultural production system.

In recognition of the vital role the Integrated Pest Management plays in agricultural and forest productivity, and to further encourage the application of Integrated Pest Management—I P M, a national award, called "Dr. Bap Reddy National Award in Integrated Pest Management", has been established. This was announced recently by the President of the Plant Protection Association of India, Dr. N. C. Joshi, Director of Central Plant

Protection Training Centre, Hyderabad. This will be awarded by the Plant Protection Association of India whose headquarters is situated at the Central Plant Protection Training Institute, Hyderabad.

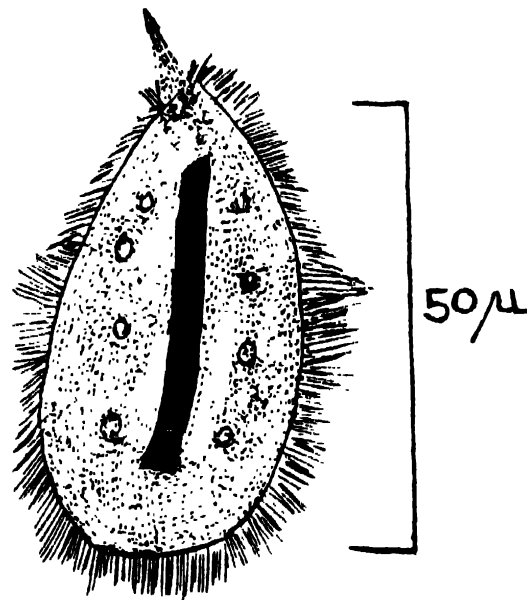
Dr. D. Bap Reddy, an eminent agricultural scientist, has worked in India and with the Food and Agriculture Organisation of the United Nations, is a pioneer in plant protection. The Award will be given to those who are engaged in research, development, promotion or practice of Integrated Pest Management, including farmers. A donation of Rs. 5,000 (Rupees Five Thousands) was made by Dr. Reddy for this purpose. The interest accrued on this amount will form the award. □

LETTERS TO THE EDITOR

On a new sub-species of *Maupasella nova*
Cepede 1910 (Protozoa : Ciliophora)
from a Indian earthworm

This note deals with the description of a new sub-species of *Maupasella nova* Cepede 1910 found in the alimentary canal of an oligochaeta : Annelida *Perionyx excuvatus*. Perrier collected from Barrackpore, near Calcutta, W.B., India.

So far, single viz. *Maupasella nova* Cepede^a has been described, reported and recorded from oligochaetan host only, although this species has been found to occurs in the guts of three different oligochaetan host¹. The hosts harbouring *M. nova* are *Allolobophora caliginosa* Savigny from near Paris⁴, *Metaphrya* (Pheretima) *Posthuma* (L. Vail), *M. hawavana* (Rosa) from Lahore².



Protozoa : Ciliophora : Astomatida :
Intoshellinidae

Maupasella nova anilei sub sp. nov.

Body ellipsoid, measuring 55 to 58μ long, 15-17μ broad in anterior side, 13-15μ broad, in posterior end. Cilia arranged in longitudinal rows. A spinous attaching organella at

anterior end with fibrils. Contractile vacuoles 8-10 in numbers arranged in two rows. Macronucleus elongated, granular structure, ribbon shaped placed almost middle of the body extending four fifth of the body. Micronucleus spindle shaped placed near the middle of the Macronucleus with its axis parallel to the body. Size of Macronucleus is $48\mu \times 6\mu$.

The proposed sub-species under report differs from *M. nova* mainly in measurement⁶, contractile vacuoles number and place and shape of micronucleus. The micronucleus of *M. nova* is fusi form⁷, where as this form is spindle shaped.

Measurements in microns

Length of the body.....55-58
Width15-17ant., 13-15 post.
Thichness..... 13.5
Length of the macro-nucleus..... 48×6
Length of Micro-nucleus.....4.5
Lenght of Cilia..... 3.5-4.00
Types—Holotype on slide. Reg. No. Pt. 90.
Paratype—Two specimens on Two slides.
Reg. No. Pt. 91. Pt. 92, deposited in the National collection.
Z.S.I.

Host—*Perionyx excavatus* Perrier.

Locality—Barrackpore, 24-Pargs., W.B., India.

Date—14th April, 1971. coll. A. Chakraborti.

Remarks—The proposed new sub-species of this monogeneric species of *Maupasella*, under report was considered worth-while to publish as this form differs not only in body shape and range of measurements but others distinct characters eg., numbers of contractile vacuoles; position and shape of the micronucleus. Hence opportunity has been taken to describe this form under new taxa in the status of sub-species novo.

The authors are deeply indebted to Dr. B. K. Tikader, Ex-Director; Dr. A. Singh, Scientist 'D', Dr. J. M. Julka, Scientist 'C' Zoological Survey of India for the facilities

provided in connection with this work. Thanks are also due to Dr. Ashoke Kumar Das, Scientist, H. Q. Calcutta for constant encouragement and valuable suggestion, for preparing manuscript.

The name *M. Nova anilei* is proposed for this new sub-species after the name of Dr. Anil Kumar Mandal, a Parasitologist of our deptt.

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Received : 17 December, 1984.

Revised : 17 June, 1986.

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Studies on the glycogen level in some tissues of a fresh water fish *Heteropneustes fossilis* (Bloch) in relation to breeding cycle

Information on carbohydrate metabolism in fishes is scanty and patchy. Glycogen constitutes a rich source of energy. Seasonal glycogen changes of various tissues are influenced by maturation cycle. Gonads have remained comparatively less studied, despite their vital importance in the propagation of fish crop. Similarly liver and muscle also play important role in maintaining the normal physiological condition of all animals, inclu-

ding the fishes besides it greatly supplements the varied needs of the gonad. Earlier workers¹⁻¹⁰ worked on different piscine tissues during maturation cycle. This paper embodies results on the glycogen changes of female *Heteropneustes fossilis* on monthly basis for one complete year, 1984 July to 1985 June. Seasonal glycogen level in liver, ovary and muscle tissues can be divided into preparatory (late April-May), active (June-August) and quiescent (September-March) phases respectively¹¹.

Live female specimens of *H. fossilis* were collected from Calcutta local markets. Genital papila is absent in the female fishes¹². They were acclimatized to laboratory condition in a large aquarium and regularly fed with tubifex.

At the time of autopsy the fishes were weighed to the average grams (40-100g) and lengths (20-27 cm) and then sacrificed. For the analysis of glycogen 6 pieces of weighed liver (av. wt. 20 mg), ovary (av. wt. 20 mg) and muscle (av. wt. 20 mg) tissues are collected. Glycogen content of the tissues was estimated by employing the method of Scifter *et al.*¹³ by using anthrone. Percentage of transmission (PT) of the blue colour was recorded spectrophotometrically against a blank at 620 m μ filter Erma Colorimeter (Japan).

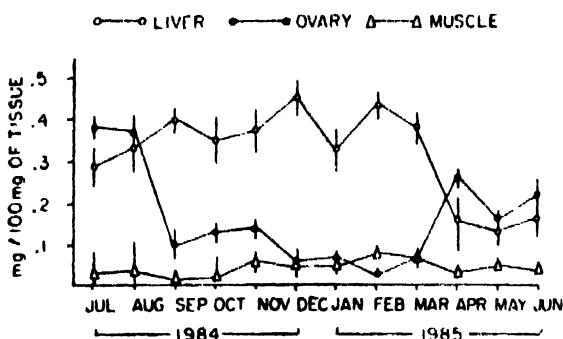


Fig. 1. Seasonal variations of the glycogen of liver, ovary and muscle of the female *Heteropneustes fossilis* (Bloch).

The glycogen level of female of *H. fossilis* has been presented in Figure 1 for one complete year. It is apparent from Figure 1 that

during the months of preparatory phase (late April-May) and active phase (June-August) the amount of glycogen in the ovary is maximum in comparison to the amount in liver and muscle tissues. During the months of quiescent phase (September-March) the amount of glycogen in the liver tissues is increased in comparison to the amount in the ovarian and muscle tissues. Significant differences of the glycogen level in the muscle tissues were also marked during all the phases.

The information concerning the biochemical changes particularly the glycogen level in liver, ovary and muscle tissue of a common fresh water edible fish *H. fossilis* at different seasons of the year is inadequate. Investigation have been undertaken to show the changes of the glycogen in the liver, ovary and muscle tissues at different months of the year.

In the present study the results show that the glycogen level is the liver and muscle reduced during the breeding season and enhanced during the non-breeding months. On the other hand, the ovarian glycogen showed a higher value in the breeding season and lower level in non-breeding season (Fig. 1). The depletion of glycogen from the somatic tissue, such as liver and muscle, and the simultaneous accumulation of this substance in ovary in breeding period suggests a mobilization of such energy reserve from the former organs possibly for helping the ovarian growth leading to maturation of eggs and spawning. The increased glycogen content of the ovary is likely to be the result of its increased synthesis, and its reduction in liver and muscle may be due to decreased synthesis and/or increased breakdown. Both phosphorylase and glycogen synthetase activities in the liver have been reported to be very low at the time of vitellogenesis^{8,11,14}. The liver glycogen level is the net result of the relative activity of these two enzymes. The reduction of liver and muscle glycogen with the concomitant enhancement of ovarian glycogen during

vitellogenesis in other fishes have also been reported^{1, 2, 4, 5, 9, 10, 12, 15}. The glycogen content in the ovary increases about 3-fold during breeding cycle in *H. fossilis*.

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Revised : 20 November, 1986.

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Spectrophotometric determination of gallium(III) with 1-(2-Thiazolylazo)- 2-naphthol

Heterocyclic azodyes give^{1,2} sensitive and/or selective colour reactions with metal ions in polar and/or non-polar solvents.

Following the application of 1-(2-pyridylazo)-2-naphthol (PAN), 4-(2-pyridylazo) resorcinol^{1, 3, 4} (PAR), 4-(2-thiazolylazo) resorcinol² (TAR), 4-(2-thiazolylazo)-pyrocatechol² (TAPC) and 1-(2-thiazolylazo)-2-naphthol-3, 6-disulphonic acid² (TAN 365) for spectrophotometric determination of gallium(III), the reaction between gallium (III) and 1-(2-thiazolylazo)-2-naphthol (TAN) has been studied.

Gallium(III) reacts with 1-(2-thiazolylazo)-2-naphthol in acidic media, the resulting red-coloured sparingly soluble chelate being soluble in dioxan-water mixtures. Maximum absorbance of the complex, observed in presence of 16-20% (v/v) of dioxan, decreases after 15 min but acetone is found to stabilise the complex. Constant maximum absorbance is now obtained in presence of 0.5 ml (2% v/v) to 2.0 ml (8% v/v) acetone and 4.5 ml (18% v/v) to 3.0 ml (12% v/v) dioxan, the total volume of acetone and dioxan employed being 5.0 ml. Absorbance measurements are made at 570 nm in the pH range 2.9-3.1 on a Spectromom 204 spectrophotometer with matched 10 mm cells.

Composition of the complex is established by Job's continuous variation and mole ratio methods as 1 : 1 and formation constant (log K), calculated by these methods, is found to be 3.45 and 3.71 respectively. The complex adheres to Beer's law over the concentration range 0.1-2.0 µg of gallium (III) per ml, has molar absorptivity 1.92×10^4 lit mole⁻¹ cm⁻¹, Sandell sensitivity 3.6 ng of Ga cm⁻² for an absorbance of 0.001 and is stable for 2.5 h. From ten repeat determinations with 50 µg of gallium(III) per 25 ml, coefficient of variation and relative mean error are found to be $\pm 0.40\%$ and $\pm 0.71\%$ respectively.

Interference of 46 ions has been studied with 50 µg of Ga(III) per 25 ml, setting the tolerance limit to cause an error of $\pm 2\%$ in determination of gallium. Tolerance limits (in µg) are : Br⁻, Mg(II), Ca(II), Sr(II), Ba(II) 6000 ; succinate, Be(II) 2000 ; SCN⁻

1750 ; thiourea, Al(III) 1500 ; I⁻, urea 1000 ; S₂O₃²⁻ 750 ; Mn(II) 500 ; Ag(I), Hg(II) 400 ; SO₄²⁻, NH₂OH.HCl 200 ; Rh(III) 150 ; N₂H₄.H₂SO₄, ascorbate, Pb(II), Ge(IV) 100 ; CN⁻, Cd(II), Ru(III), La(III), Bi(III), Se(IV), Te(IV), Pt(IV), Mo(VI) 50 ; Ti(III) 25 ; F⁻, EDTA⁴⁻, citrate, malonate, oxalate, tartrate, Fe(II, III), Zn(II), Sc(III), In(III), Sb(III) nil. Hg(II), Ru(III), Bi(III), are masked by I⁻ and Cd(II) by SCN⁻.

General procedure : The pH of an aliquot of gallium(III) chloride solution containing 2.5-50 µg of gallium is adjusted to 3.0 with 0.05 N NaOH. To this solution are added 1 ml of 0.1% (v/v) TAN, 5 ml of acetone-dioxan (1 : 4) mixture, contents diluted to 25 ml with doubly distilled water and absorbance measured after 30 s at 570 nm against a reagent blank prepared under identical conditions.

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Effectiveness of some organic manures on the growth of three Indian major carps

The effect of manures on the growth of carps has been studied by a number of workers¹⁻⁷. In this work the poultry manure and gobargas slurry were selected to show their effectiveness on the growth of *Catla catla* (Ham.), *Labeo rohita* (Ham.) and

Cirrhinus mrigala (Ham.). The experiment was conducted for 180 days in a village, Joykrishnabati, District Burdwan, West Bengal. Three ponds were selected one of which was treated with poultry manure (EP_I, at the rate of 5000 kg/ha), the second one with gobar gas slurry (EP_{II}, at the rate of 8000 kg/ha) and the third one was not treated with any manure and kept as control (CP_I). The fry (induced breed) was released at the rate of 20,000 ± 10%/ha (average weight in g/total length in cm : Catla—1.6/5.6, Rohu—0.5/3.9, Mrigal—2.7/7.3), the ratio being 4 Catla : 3 Rohu : 3 Mrigal. No artificial food was supplied. The growth of the species is given in Fig. 1.

The growth performance of Catla was found to be the best in all the three ponds, followed by Rohu and Mrigal in that order. It was also noted that the average weight in g of Catla at the end of the experiment in the pond treated with poultry manure was 350 ± 9.0, Rohu—300 ± 6.5 and Mrigal—230 ± 4.9 and that in gobar gas slurry treated-pond, Catla—250 ± 2.9, Rohu—200 ± 1.5 and Mrigal—180 ± 2.6. In comparison to the control pond (Catla—122 ± 5.8, Rohu—80 ± 4.5 and Mrigal—67 ± 1.5), the growth of these species in the treated ponds was much better and of the three, poultry was the best.

From the experiment conducted by Das *et al.*⁶ using cowdung and chemical fertilizer and also supplementary feeding, it was found that Catla grew at a rate of 55 g/month or 1.83 g/day, Rohu—56.3 g/month or 1.88 g/day. Keshabnath *et al.*,⁸ using cowdung and poultry manure observed daily growth rate of 2.75 g, 2.36 g and 2.18 g for Catla, Rohu and Catla-Rohu hybrid respectively during 105 days of rearing. In another set of experiment conducted by them, the respective growth rates/day were 2.64 g, 1.33 g and 1.35 g. In comparison to the result of these workers, the growth rate of the three major carps obtained by utilising poultry in the present experiment, were 1.93 g, 1.66 g and 1.25 g for Catla, Rohu

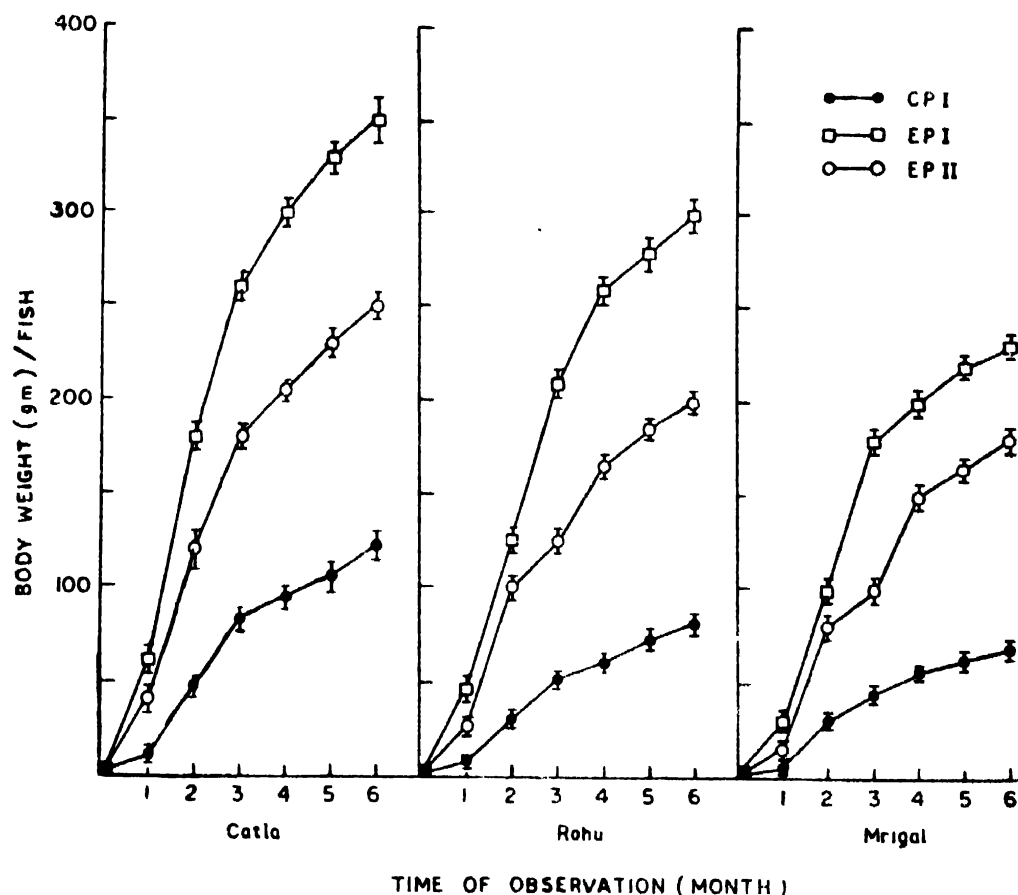


Fig. 1. Growth of Catla, Rohu and Mrigal in 6 months (CPI-Control, EPI-Poultry treated, EPII-Gobargas Slurry treated).

and Mrigal respectively. The respective growth rates of these three species in gobargas slurry treated ponds were 1.38 g, 1.10 g and 0.97 g. However, the rate of growth in the control pond was much lower (0.66 g, 0.44 g, 0.35 g in Catla, Rohu and Mrigal respectively). So, the growth rate as observed for different species in this experiment and also the final growth of these species have similar trend. Catla grew faster than the other two species and all the species showed better growth in poultry treated pond. Therefore, the results conclusively prove the better ability of the poultry manure to enhance the growth of these carps due to better growth of plankton, the fish food. Moreover, the manure is easily available in the rural areas or available at cheaper rate. If the pisciculturists of the rural area are encouraged to use poultry in carp culture it

would be effective in boosting up the fish production

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Schiff bases of Khusilal

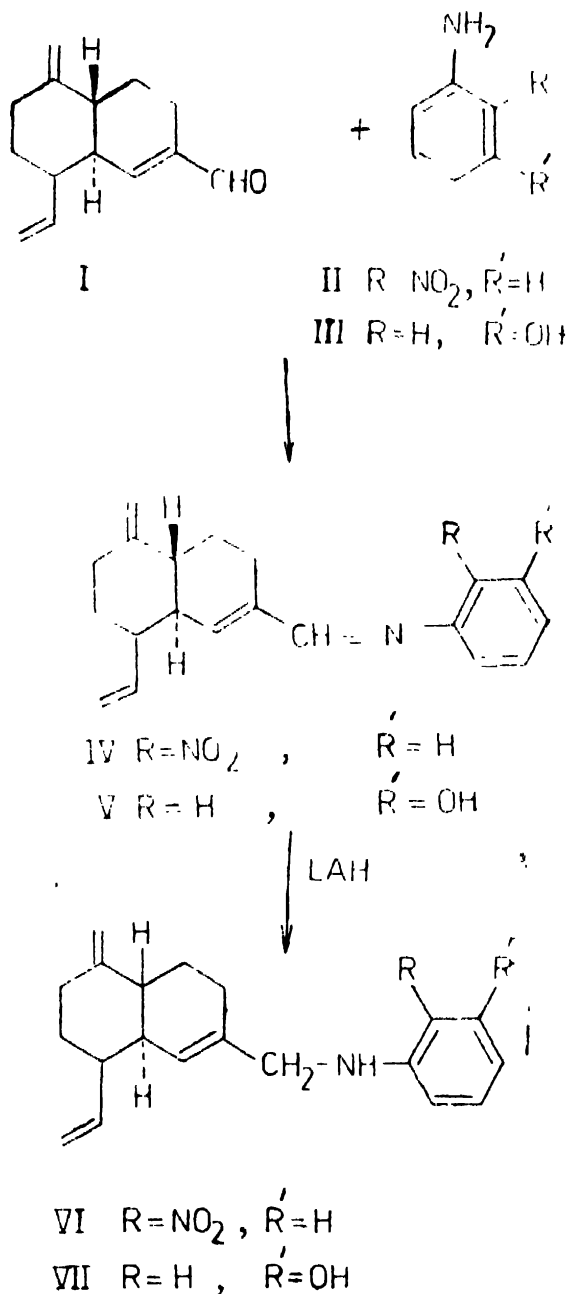
Although condensation of aldehydes with primary amines¹⁻³, their reduction⁴ and various addition reactions⁵ have been reported in literature but no effort has been made so far to study the condensation of primary amines with sesquiterpene aldehydes. The title investigation was therefore undertaken and the results are reported in this paper.

Condensation of Khusilal (I) with O-nitroaniline (II) in toluene at 150°C yielded crystalline compound (IV) m.p. 63°C. Reduction with LAH gave (VI). Similarly condensation of (I) with m-aminophenol (III) in toluene gave crystalline dark-brown solid (V) m.p. 88°C. Reduction of V with LAH to yield VII failed even at high temperature.

Schiff bases (IV & V) have been characterised by spectral data. From the IR study it is evident that the conjugation in azomethines affects the position of $>C=N$ group; it absorbs at 1675 cm^{-1} (IV) and 1600 cm^{-1} (V). NMR(IV) shows signals at 8.25δ (O-nitrosubstituent in benzene ring), $6.9-7.5\delta$ (m, 4H, aromatic protons), 6.36δ (s, 1H, $\text{CH}=\dot{\text{C}}-\text{CH}=\text{N}-$), 7.7δ (1H, $-\text{HC}=\text{N}-$, azomethinic protons). NMR (V) shows signals at 7.4δ (1H, $-\text{CH}=\text{N}-$), 7.75δ (1H, Phenolic proton), 6.3δ ($-\text{CH}=\dot{\text{C}}-\text{CH}=\text{N}-$) and 4.4δ ($>\text{C}=\text{CH}_2$).

A study of the spectra of reduced product (VI) in conjugation with that of the parent Schiff base (V) reveals that the observed

bands assigned to azomethinic linkage ($>\text{C}=\text{N}-$) are absent but contains additional bands (3495 , 3360 and 1260 cm^{-1}) assigned to N-H stretching and C-N stretching respectively. NMR spectrum showed



signal at 3.6δ assigned to $>\text{N}-\text{H}$ proton, confirming the reduction. Reduction of Schiff base (V) was not possible with LAH as hydroxyl group was present in the N-phenyl ring. The presence of hydroxyl group in the N-phenyl ring increases the electron density around the $>\text{C}=\text{N}$ bond which

repels the attacking hydride ion (from LAH). So the reduction does not take place.

Melting points were determined on a Kofler hot block and are uncorrected. IR spectra ($V_{max-cm^{-1}}$) were recorded in nujol and NMR spectra in $CDCl_3$ with TMS as an internal standard, chemical shift in δ -scale. The purity of the products obtained at each stage was checked by thin layer chromatography (TLC). TLC was carried out using silica gel G (BDH). Visualization of spots was done by spraying with sulphuric acid/methanol (1 : 1) followed by heating at $110^\circ C$.

The method for carrying out reactions consists of refluxing (using Dean & Stark apparatus) azeotropic distillation, extraction with ether, drying (Na_2SO_4) followed by chromatography over silica gel and crystallisation of the product.

A solution of I (2 ml) and II (1.38 g) in toluene (50 ml) on refluxing for 6-8 hours at $150^\circ C$ afforded the Schiff base (IV) which was purified by crystallisation m. p. $63^\circ C$ yield 90%.

IR 3080, 1634, 892 ($>C=CH_2$), 1795, 950, 918 ($-CH-CH_2$, vinylic double bond), 840, 810, 785 ($-CH-CR_1R_2$, trisubstituted ethylenic linkage), 870, 610 ($>C-NO_2$), 1560, 1490, 1400, 1180, 745, 695 cm^{-1} (Phenyl).

NMR ($CDCl_3$) 8.25 δ (S, ortho-nitrosobstituent in benzene ring), 7.7 δ (S, 1H, $-HC=N-$, azomethinic proton), 6.9-7.5 δ (m, 4H, aromatic protons), 6.36 δ (S, 1H, $-CH=\dot{C}-CH=N-$), 5.1-5.5 δ (m, $-\dot{C}H=CH_2$, vinylic double bond) 4.65-4.75 δ (d, 2H, $>C=CH_2$, exocyclic double bond).

Reduction of Schiff base IV (1g) with LAH (0.5 g) in dry ether (50 ml) was carried out. Work up yielded VI (TLC, IR, NMR).

IR 3495, 3360 (N-H), 2940, 1460, 892 ($>C=CH_2$), 1795, 950, 918 ($-CH=CH_2$, vinylic double bond), 840, 810, 785 ($-CH-CR_1R_2$, trisubstituted ethylenic linkage), 870,

610 ($>C-NO_2$), 1560, 1490, 1440, 1180, 745, 695 cm^{-1} (Phenyl).

NMR ($CDCl_3$) : 8.25 δ (O-nitrosobstituent in benzene ring), 6.9-7.5 δ (m, 4H, aromatic protons), 6.36 δ (S, 1H, $-CH=\dot{C}-CH_2-NH$), 5.1-5.5 δ (m, $-CH=CH_2$), 4.65-4.75 δ (d, 2H, $>C=CH_2$), 3.6 δ (t, 1H, $-N-H$; missing on D_2O exchange).

A solution of I (2 ml) and m-aminophenol (1.1g) in toluene (50 ml) were refluxed for 6-8 hours at $150^\circ C$, afforded the derivative V. m.p. $88^\circ C$ yield 85%.

IR 3370, 1380, 1180 (Phenol), 3080, 1650, 900 ($>C=CH_2$), 1600 ($>C=N$), 1740, 965, 910 ($-HC=CH_2$, vinylic double bond), 840, 810, 775 ($-CH=CR_1R_2$, trisubstituted double bond), 1460, 1280, 740 cm^{-1} (Phenyl).

NMR ($CDCl_3$) 7.75 δ (Phenolic protons), 7.4 δ (S, 1H, $-CH=N-$), 6.9-7.5 δ (m, 4H, aromatic protons), 6.36 δ (S, 1H, $-CH=\dot{C}-CH-N-$), 5.1-5.5 δ (m, $-CH=CH_2$), 4.65-4.75 δ (d, 2H, $>C-CH_2$).

A solution of V (1 g) in dry ether (50 ml) was refluxed with LAH (0.5 g) at $40-50^\circ C$ for 3-5 hours. The colour of mixture changed from brick red to brown. Work up yielded solid compound m.p. $88^\circ C$ (identical with V).

One of the authors (K. K. C.) is thankful to CSIR, New Delhi for the award of a Research Associateship.

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Planting time and calcium carbide treatment for round-the-year harvest of pineapple in North Bengal

Pineapple is one of the few fruit crops which is very responsive to the induction of flower bud by using growth substances. It is, therefore, possible to induce flowering and get ripe fruits at different times of the year by the application of chemicals like ethrel (2-chloroethyl phosphonic acid)^{1,2} ;

NAA (α -naphthalene acetic acid)^{3,4} and calcium carbide⁵. Considering the availability of chemicals and its cost, the present investigation was carried out to formulate a schedule for year-round harvest of pineapple with calcium carbide.

Slips of Kew pineapple (wt. 350-400 g) were planted from July to November at a plant density of 64,000/ha. The plants were fertilized with N, P and K at 600, 400 and 600 kg/ha respectively. The slips were

TABLE 1 : Planting time and calcium carbide (20g/l) treatment for round-the-year harvest of pineapple

Planting time (1982)	Time of application (1983)	Days required for emergence of inflorescence	Time of harvest
15th July	8th July	28	6th December
	22nd July	35	8th January
	8th August	35	20th February
	15th August	37	15th March
	8th September	40	16th April
	15th September	43	8th May
15th August	8th August	38	20th February
	15th August	37	3rd March
	8th September	54	10th April
	29th September	135	22nd May
	8th October	116	24th July
	22nd October	104	27th May
15th September	8th September	56	22nd April
	15th September	41	21st May
	29th September	68	23rd April
	8th October	110	10th June
	22nd October	73	11th May
	29th October	50	16th June
	8th November	62	11th July
	8th October	59	25th June
15th October	29th October	53	2nd July
	15th November	53	4th August
	8th December	82	5th September
	22nd December	63	8th September
	29th December	93	3rd October
	22nd November	74	26th July
	22nd December	49	27th July
15th November	22nd January	23	16th August
	29th January	32	3rd September
S. E. \pm		4.12	
C. D. at 5%		12.4	

treated with calcium carbide (20 g/l) at 7-day intervals from 365 to 420 days after planting. Fifty ml of solutions were applied at the core of the plant in the evening. The experiment was carried out in randomised block design with six replications per treatment. For round-the-year harvest, the important results are presented in Table 1.

An early emergence of inflorescence was observed by treating the plants in the month of July-August while it was delayed in October, November and December (Table 1). It was also noted that treatment of chemicals at 365-380 days after planting was more effective than application at later stages. Das Biswas *et al.*² recorded early emergence of inflorescence in pineapple by applying calcium carbide in the month of June compared to October. Variations in the days required for inflorescence emergence led to harvesting of fruits in different months and a staggering of fruit harvest almost throughout the year. In North Bengal, pineapple is generally planted in November and harvested during June-July.

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Comparative efficacy of four herbicides on seed setting in *Allium cepa*

The immense use of herbicides in the modern agriculture has created a very keen interest over the last two decades. According to Hilton *et al.*¹, the mode of action of herbicide in a plant was more specific to its structure. Studies of Moreland and Hill² revealed that herbicides influence the Hill reaction, depending on the structure and functional groups of the chemical formulae. Several workers reported that some herbicides possess growth-regulating³ properties, some behave as mutagens⁴, etc. In view of these aspects, the present experiment was conducted to see the behaviour of different selective herbicides on seed setting in *Allium cepa* L.

The experiment was conducted at R. B. S. College, Research Farm, Bichpuri, Agra. Popularly known onion variety 'Nasik Red' was chosen and its bulb were sown in December, 1985. The field was totally free from previous weedicidal application. Aqueous solutions (2 ml each) of four herbicides at different concentrations were injected in the selected scapes of 5 onion plants for each treatment at the time of bud initiation. All the necessary agronomical operations were done till the crop was ready for harvesting. The umbels of treated as well as untreated plants were collected and seeds were taken out separately. The seed setting per flower was calculated by counting the total number of seeds obtained from flowers of an umbel and total number of flowers from individual umbels was counted.

A perusal of Table 1 revealed that the four herbicides affected seed setting in onion quite differently. Lower concentrations, i.e. 1 ppm, 5 ppm and 10 ppm of Benthicarb, Isoproturon and Metaxuron increased the rate of seed setting per flower over the untreated plants. In Diclofopmethyl, maxi-

TABLE 1: Average value of seeds produced by individual flower at different concentrations of four herbicides

Name of Herbicide	Chemical Name	Active ingredient	Concentration in ppm							
			1	5	10	100	500	1000	5000	10,000
Benthiocarb (Saturn)	S-(4-Chlorobenzyl)- N, N-diethyl thiol- carbamate	50% w.p.	2.44 ±0.0124	2.49 ±0.020	2.58 ±0.0004	2.54 ±0.0419	1.87 ±0.053	1.65 ±0.024	0.49 ±0.0006	--
Isoproturon (Tolkan)	N ₄ -Isopropyl Phenyl N, N-dimethyl urea	50% w.p.	3.64 ±0.0136	2.73 ±0.0008	2.68 ±0.0006	1.59 ±0.0007	1.48 ±0.0006	1.65 ±0.02	0.72 ±0.012	*
Metaxuron (Dosanex)	N(3-Chloro, 4-methoxy Phenyl) N, N-dimethyl urea	80% w.p.	3.34 ±0.057	2.81 ±0.027	3.6 ±0.016	1.88 ±0.0003	1.52 ±0.0254	--	--	--
Diclofopmethyl (Illoxan)	Methyl 2 (4-(2, 4- dichlorophenoxy) Phenoxy Propionate	36 EC	3.6 ±0.022	2.56 ±0.013	1.6 ±0.0009	0.55 ±0.0008	--	--	--	--
Untreated	2.11 ±0.0036									

-- Treated plants died

* Plants with reduced metabolic activity

imum increase was realized at 1 ppm which declined at 5 ppm but keeping still and edge over the untreated plants. Shukla *et al.*⁵ have reported this increase in seed production in a number of weeds associated with wheat crop and have attributed this increase to the hormonal effect of herbicides at lower concentrations. Leffler *et al.*⁶ also recorded that certain herbicides like 2, 4-D at lower concentration (100 ppm) stimulate RNA synthesis.

The increase in concentration after a particular limit decreased the rate of seed setting and at higher concentrations complete sterility was noted for all herbicides. The variability of concentrations was different for each herbicide. Thus, in case of Diclofopmethyl seed-setting could be possible up to 100 ppm only. In case of Metaxuron, it was 500 ppm and with Benthocarb or Isoproturon it was 5,000 ppm. Thus, Diclofopmethyl appeared to be more penetrating than Benthocarb and Isoproturon.

The increase in herbicide concentration stopped seed formation. It was further accompanied by yellowing, burning and ultimately death of the affected plant. Plants treated with the highest concentration of herbicides died first and the lethal dose of application also differed for each herbicide. Hence, plants treated with Diclofopmethyl died first followed by Metaxuron and Benthocarb. It was interesting to note that all the plants treated with 10,000 ppm of Isoproturon did not die, they showed extremely reduced metabolic activities.

The authors are thankful to the Principal R B. S. College, Agra and to Head, Department of Botany for providing facilities and encouragement. We are also very thankful to Dr. R. K. S. Rathore for valuable suggestions and criticism during the course of this investigation. We are grateful to M/s Pestides India, Hoechst, Sandoz and May & Baker companies for their generous response

to supply the herbicides free of cost.

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Received : 18 August, 1986.

Revised : 1 December, 1986.

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Effect of three weedicides on population growth behaviour of *Pratylenchus zeae* affecting groundnut

There are many nematodes which are very specific in their host requirements. While some nematodes are completely ectoparasitic, a few are semi-ectoparasites and still others are completely endoparasitic¹. Majority of weedicides, by virtue of their selective action might influence the growth behaviour of nematodes with specific host requirements and with endoparasitic mode of existence.

In a weedicide trial on Rabi groundnut (*Arachis hypogaea* L.) var. AK—12, 24, with three chemical weedicides viz., glyphosate 36% EC, oxadiazon 25% EC and fluazifop 25% EC, the population growth behaviour of an endoparasitic nematode *Pratylenchus zeae* was monitored to see if these weedicides have any effect on it. Each weedicide was taken in two independent dosages of 0.75 kg and 1.0 kg a.i./ha and the third of 0.75 kg a.i.

combined with 0.25 kg a.i./ha of 80% sodium salt of 2, 4-D. Thus, there were nine chemical treatments and an untreated unweeded control; these were in R. B. D. with three replications. The weedicides were applied as pre-emergence soil applications three days following groundnut sowing. To monitor growth in the nematode populations, soil samples were drawn randomly from the rhizosphere, six times at an interval of three weeks since sowing. Nematodes were processed through Cobb's sieving and decantation technique, concentrated into a 3 ml suspension, killed over hot water bath and preserved in 2% formaldehyde. Nematodes were counted speciewise and analysed statistically following $\sqrt{n+1}$ transformation. The rate in population growth (R) was calculated by dividing the final population (PE) at harvest

by the initial population (PI) recorded at sowing.

Nine species of monocot weeds, viz. *Echinochloa colonum* (L.) Link, *Eleusine indica* Gaertn., *Commelina benghalensis* L., *Cynodon dactylon* (L.) Pers., *Cyperus rotundus* L., *Dactyloctenium aegyptium* Willd., *Digitaria sanguinalis* Gaudich, *Leptochloa chinensis* (L.) Nees and *Panicum repens* Jacq. were found prevailing in the control as well as glyphosate-treated plots, while they were excellently controlled in all oxadiazon and fluazifop treated plots. Dicot weeds were a few and far between.

Populations of *P. zeae* were found steadily rising from sowing onwards till harvest in all the plots, but those in glyphosate treated plots as well control (where monocot weeds prevailed) were finally statistically

TABLE 1 : Effect of weedicides on population dynamics of *P. zeae**

Date/ Treat- ment**	D ₁ (25.11.84)	D ₂ (17.12.84)	D ₃ (8.1.85)	D ₄ (29.1.85)	D ₅ (19.2.85)	D ₆ (12.3.85)	Mean	R value (Based on original data)
Soil Temp. at 30 cm depth	23.2°C	23°C	23.7°C	23.6°C	22.9°C	27.2°C		
G ₁	5.903	6.280	8.853	12.257	16.997	24.877	12.528	18.84
G ₂	5.363	6.417	11.337	15.880	21.437	30.187	15.103	31.50
G ₃	5.503	6.843	8.420	11.587	16.597	24.223	12.196	18.67
O ₁	7.313	7.370	7.513	8.750	10.423	14.983	9.392	4.19
O ₂	6.483	8.690	8.807	10.907	12.010	14.113	10.168	4.26
O ₃	5.463	5.527	6.267	7.640	9.620	12.397	7.819	5.29
F ₁	6.637	8.040	8.143	11.327	13.597	14.953	10.449	5.67
F ₂	6.547	8.007	8.063	11.003	12.460	16.110	10.365	6.25
F ₃	7.027	7.833	7.903	9.497	11.413	13.787	9.577	3.84
C	5.650	6.763	8.120	10.183	13.573	20.773	10.845	13.29
Mean	6.189	7.177	8.343	10.903	13.812	18.640		

*Mean $\sqrt{n+1}$ transformed values of three replications, except R value column which is based on original data.

S. E (m)	Chemical	Date	Interaction (C×D)
(0.05)	0.709	0.549	1.738
C. D. (0.05)	1.987	1.539	4.867

**G = Glyphosate (Round up)
O = Oxadiazon (Ronstar)
F = Fluazifop (Fusilade)
C = Control

Chemical₁ @ 0.75 kg a.i./ha
Chemical₂ @ 1.0 kg a.i./ha
Chemical₃ @ 0.75 kg a.i./ha with 0.25 kg 2, 4-D/ha (Agrozone)

significant over oxadiazon and fluazifop-treated plots, thereby showing that the latter two chemicals were responsible for reducing nematode build-up perhaps by reducing monocot weed populations. Similar findings have also been noted by Rossner² and Gaur and Haque³. It was further seen that between the glyphosate-treated plots and control, final populations in the former were significantly higher over the latter, a fact which lead to assume that in some unknown way, glyphosate perhaps exerts some selective boosting effect on the nematode population growth. Finally, soil temperatures were seen to influence the population growth in those plots where monocot weeds prevailed. Soil temperatures prevailing between 1st and 4th date ranged between 23.2°C and 23.6°C and at this range the growth in populations were not significant; whereas soil temperatures around 5th date was 22.9°C and that around 6th date (harvest) was 27.2°C. Sixth date populations in all the glyphosate-treated plots and control being significantly higher over corresponding 5th date populations, lead to assume that temperature around 27.2°C was helpful in boosting *P. zeae* populations in the presence of abundant favourable hosts. R values in glyphosate-treated plots were very high (18.673-1.50) and in control moderately high (13.29) as against very low (3.84-6.25) in other treatments, which further confirm the fact that fluazifop and oxadiazon suppressed the populations of *P. zeae* whereas glyphosate helped it.

The authors are thankful to Dr. S. N. Das, Professor and Head, Department of Nematology for the laboratory facilities and to Mr. G. C. Tosh, Reader, Agronomy (Weed-Science) for his cooperation in the field experiment.

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Recycling potential of waste plant residues for biogas and enriched manure production

Cellulosic wastes as plant residues being organic in nature so its disposal leads to several environmental impacts. The growing concern for environmental protection coupled with urgent need for potentially useful materials to meet the increasing shortage of food, feed and energy has lead to the development of a number of process for bio-conversion of these cellulosic wastes to recoverable products. Thus recycling involves safe disposal, judicious and economic utilization of these wastes to get valuable products. During anaerobic fermentation in biogas plants about 27% of dung is converted to combustible gas and the residue left (73%) becomes available as manure¹. The residue or slurry left behind after biogas production has been found to be rich in nitrogen, phosphorus and potassium^{2,3}. The present investigation highlights the potential of various plant residues for biogas production and manure.

The plant residues i.e. lantana weed, apple leaf litter, peach leaf litter and wheat straw were treated with 1% alkali (NaOH) for 7 days to release maximum organic constituents and make tissue more accessible to microbial degradation, before subjecting them to anaerobic fermentation. Cattle dung was supplemented with these plant residues (1 : 1, w/w) at 10% slurry level and fermentation was carried out in 3 litre mini-digesters at ambient temperature (28-31°C)

for 31 days. The slurries were analyzed before and after anaerobic fermentation for organic matter content by colorimetric method⁴, nitrogen by microkjeldhal's method⁵, available phosphorus by electric calorimetric method⁶ and available potassium by photometric method⁷. Organic carbon was determined by dividing organic matter by 1.724. Biogas produced was measured by saline water displacement method and methane and CO₂ by gas chromatographic technique⁸.

Biogas produced per gram of dry matter improved by 27-33.4% when pretreated plant residues were supplemented to cattle dung. Over all biogas as well as methane production enhanced about two folds as compared to cattle dung alone (unpublished data). Lantana residue slurry showed remarkably high methane content (63.57%) followed by apple leaf litter slurry (59.57%); wheat slurry (58%) and peach leaf litter slurry (57.7%) as compared to 56.15% CH₄ in cattle dung control. The higher biogas recoveries from plant residue supplemented cattle dung was attributed to the dry matter content which provided sufficient amount of organic matter particularly hydrolyzed polysaccharides for anaerobic decomposition.

Anaerobic digestion of cattle dung and plant residue supplemented slurries caused an overall increase in N, P and K content,

although slight variations among the treatments were observed (Table 1). Such increase has also been reported by earlier workers but using different substrates⁹⁻¹⁰. N, P and K content in digested slurries increased by 9-16%; 25-50% and 22-30% respectively. The increase in above constituents can be assigned to the mineralization of organic matter present and taking into consideration the fact that higher contents of carbon and hydrogen were lost in the form of CH₄, CO₂, H₂ and other gases.

The overall C/N ratio was determined in view of earlier reports that a C/N ratio of 30 permits anaerobic fermentation to proceed at optimum level^{11,12}. However, in the present study C/N ratio in various treatments ranged from 17.58-21.97 in various slurries except wheat slurry (30.75) before fermentation. It was observed that with the reduction in total carbon there was slight increase in the nitrogen level leading to a decrease in C/N ratio. Thus C/N ratio after anaerobic fermentation varied from 8.69 to 12.26. The variability was due to difference in C/N ratio of feed material and its concentration employed for anaerobic digestion. The C/N ratio of 17-22 has been observed to be better for methane production. It is pertinent to point out here that it is not the C/N ratio analyzed but the C/N ratio that is available to the methanogens which need to

TABLE 1 : Comparative manurial values of effluent after anaerobic fermentation of cattle dung supplemented plant residues against farm yard manure (FYM)

Constituents	Before anaerobic fermentation		After anaerobic fermentation for 31 days				
	FYM* %	Cattle dung %	Cattle dung %	Lantana %	Apple %	Peach %	Wheat %
Nitrogen	0.4-1.3	2.037	2.217	2.170	2.240	2.140	1.590
Phosphorus	0.3-0.9	0.211	0.322	0.316	0.333	0.352	0.305
Potassium	0.3-1.9	0.540	0.735	1.555	1.725	1.780	0.930
C/N ratio	—	17.580	8.690	9.380	9.610	9.300	12.260
Ash content	—	12.15	12.60	13.560	9.480	8.960	10.970

*See reference 13.

be explored and one has to check the factors like N-limitations or ammonia toxicity.

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Comparative efficacy of Isoproturon and Metoxuron on common weeds of wheat

Weeds constitute an important factor in the management of all land and water resources, but their effect is the greatest on agriculture. Out of total losses caused to agriculture from various agencies weeds inflict the maximum. As the number of crops has increased with the human need the number of weeds has also increased in the same proportion. According to Singh¹, grassy weeds such as *Phalaris minor* and *Avena fatua* are on the increase year after year with the introduction of high-yielding dwarf varieties of wheat. A good number of selective herbicides are available in the market to control both grassy and broad-leaved weeds. To control weeds in wheat crop, formulations of Isoproturon and Metoxuron are commonly used in our country. Keeping in view the weed flora of Agra associated with the wheat crop, both these herbicides have been evaluated for their comparative efficacy.

An important contribution was made to the history of herbicides when Bucha and Todd² found that Monuron [N¹-(chlorophenyl)-NN-dimethylurea] was very effective in controlling many species, especially annual and perennial grasses. A number of chemicals have been developed and tested for their efficacy in controlling many weeds. As stated by Gill and Brar³, Isoproturon @ 1.5 kg a.i./ha and Metoxuron @ 2-4 kg a.i./ha gave better control of grassy and non-grassy weeds. According to Shukla *et al*⁴, Metoxuron @ 1.5 kg a.i./ha showed pronounced effects on *Chenopodium*, *Coronopus*, *Anagallis* and

TABLE 1 : Showing frequency, density and abundance of various weeds studied in different treatments

Treatment	Parameter	<i>Anagallis arvensis</i> L.	<i>Chenopodium album</i> L.	<i>Convolvulus arvensis</i> L.	<i>Cynodon dactylon</i> (L.) Pers.	<i>Cyperus rotundus</i> L.	<i>Melilotus indica</i> (L.) All.	<i>Pluchea lanceolata</i> Cl.	<i>Polygonum plebejum</i> R. Br.	<i>Spergula arvensis</i> L.
Control	Frequency %	67.00	100.00	100.00	100.00	100.00	100.00	33.00	100.00	50.00
	Density m/sq	2.50	13.83	5.17	79.50	4.50	99.50	1.83	11.50	1.00
	Abundance m/sq	3.75	13.83	5.17	79.50	4.50	99.50	5.50	11.50	2.00
Isoproturon	Frequency %	—	33.00	67.00	100.00	67.00	100.00	—	67.00	—
	Density m/sq	—	0.83	3.67	36.00	4.33	19.83	—	3.67	—
	Abundance m/sq	—	2.50	5.50	36.00	5.20	19.83	—	5.50	—
Metoxuron	Frequency %	—	33.00	100.00	67.00	67.00	100.00	—	—	—
	Density m/sq	—	0.50	3.17	9.50	2.00	25.83	—	—	—
	Abundance m/sq	—	1.50	3.17	14.25	3.00	25.83	—	—	—
(—) Total elimination of plants										

Spergula after two weeks of spraying and on *Phalaris* upto six weeks of spraying whereas Isoproturon (50%) @ 1.75 kg a.i./ha lowered the population of *Chenopodium*, *Melilotus* and *Phalaris* by two weeks.

The experiment was conducted at R.B.S. College, Research Farm, Bichpuri Agra, during the winter season of 1984-85. The experimental field was totally free from any previous herbicidal treatment. The field was prepared for the sowing of 20 varieties and 7 species of wheat. All the materials were sown in 3 plots on December 18, 1984. First irrigation was done on January 9, 1985 and top dressing with urea on 17 January, 1985. Two plots were sprayed with two herbicides, namely Graminon (Isoproturon 50 W.P.) and Dosanex (Metoxuron 80 W.P.) @ 2.0 kg a.i./ha, 35 days after sowing while one plot was kept as control (untreated) and sprayed with water only. Effects caused by herbicides became apparent a week after spraying, with yellowing and curling of leaves. The yellowing was soon converted into burning of leaf apex and the herbicidal action soon spread all over the treated plants basipetally. Frequency, density and abundance were recorded by quadrat (1.0 m × 1.0 m) study in all the treated and untreated plots, 24 days after spray.

Dhiman and Kairon⁶ studied that Tolkan (Isoproturon 50%) @ 1.0 kg a.i./ha compressed weed flora by 24% for *Phalaris minor* 34% for *Chenopodium album* and 23% for *Lathyrus aphaca* and other weeds. According to Shukla⁷, the frequency of *Chenopodium album* was decreased upto 50% while density and abundance was less effected in Isoproturon-treated plots. The same worker also observed that in Isoproturon-treated plot *Convolvulus arvensis* was recorded only in third count and their frequency, density, abundance were recorded lowest while in *Melilotus indica* the frequency was recorded 90% in Isopro-

turon as well as in Metoxuron-treated plots after 15 days of herbicidal treatment. Density and abundance were also effected in accordance with frequency in both the treated plots. Similarly, *Polygonum plebejum*, *Spergula arvensis*, *Cynodon dactylon* and *Cyperus rotundus* were also some what affected with both the herbicides.

Table 1 reveals the frequency, density and abundance of 10 weed species in treated as well as untreated plots. Out of these, *Melilotus indica* ranked first in all the characters studied in comparison with other weeds. All the weed species were effectively controlled with the application of the two herbicides @ 2.0 kg a.i./ha in separate plots. In all, 9 weed species were concerned, three of them—*Anagalis arvensis*, *Pluchea lanceolata* and *Spergula arvensis* were completely destroyed by both herbicides. *Polygonum plebejum* was effectively controlled with Isoproturon and completely destroyed with Metoxuron. Remaining weed species declined significantly

The authors express their sincere thanks to the Principal and Head, Department of Botany, R.B.S. College, Agra for providing necessary research facilities and to M/s. Hindustan Ciba-Geigy Ltd., Bombay and M/s. Sandoz India Ltd., Bombay for supplying the chemical Isoproturon and Metoxuron respectively as free samples.

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Revised : December, 1986

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**Particulars of the Journal *Science and Culture* as per form IV of the
Registration of Newspapers (Central) Rules. 1956**

Place of Publication : Calcutta. Periodicity of Publication : Once a month. Printer's and Publisher's Name, Nationality, Address : Prof. Santimay Chatterjee, Indian, Indian Science News Association, 92, Acharya Prafulla Chandra Road, Calcutta-700009. Editors' Name, Nationality, Address : (1) Prof. S. C. Datta, Indian, Dept. of Botany, Calcutta University, Calcutta-700019; (2) Dr. B. B. Baliga, Indian, Saha Institute of Nuclear Physics, 92, Acharya Prafulla Chandra Road, Calcutta-700 009 ; (3) Dr. Santimay Chatterjee, Indian, A-1, Punjanirh, 164/78, Lake Gardens, Calcutta-700 045 ; (4) Dr. A. N. Daw, Indian, Dept. of Radiophysics & Electronics, Calcutta University, 92, Acharya Prafulla Chandra Road, Calcutta-700 009 ; (5) Dr. S. B. Karmohapatro, Indian, Saha Institute of Nuclear Physics, 92, Acharya Prafulla Chandra Road, Calcutta-700 009. Names and Address of individuals who own the newspapers and partners or shareholders holding more than one per cent of the total capital : Indian Science News Association, Calcutta.

I, Prof. Santimay Chatterjee, hereby declare that the particulars given above are true to the best of my knowledge and belief.

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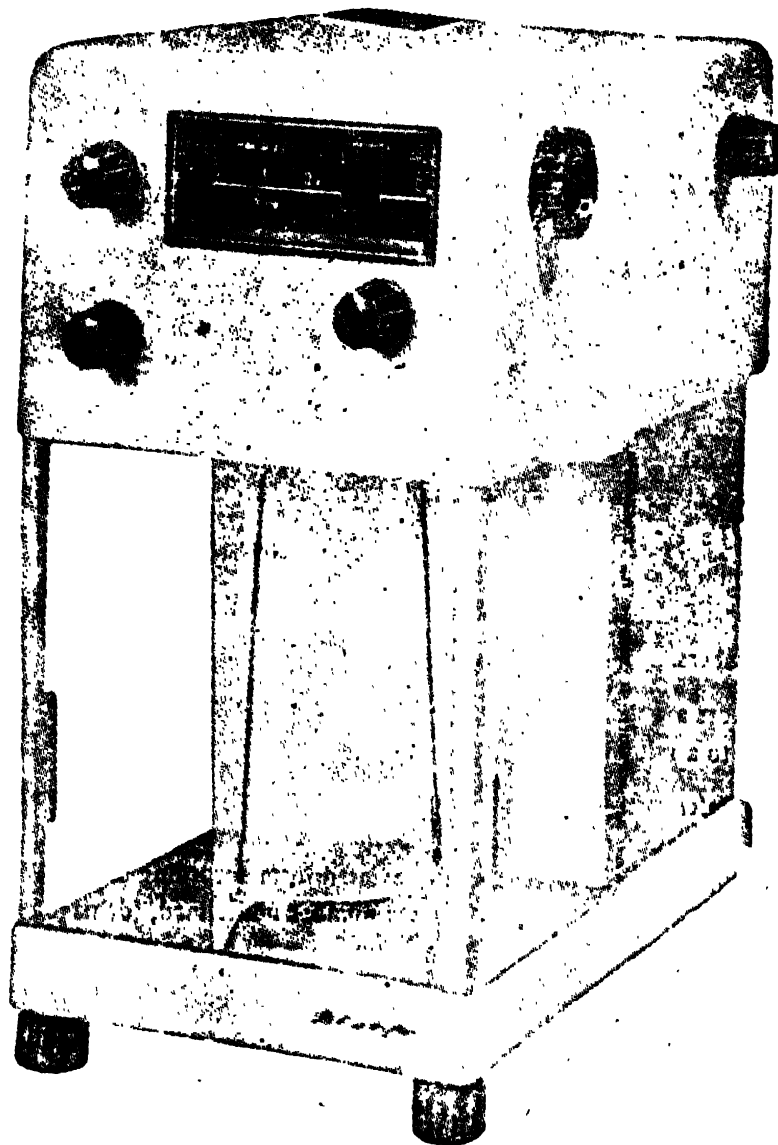
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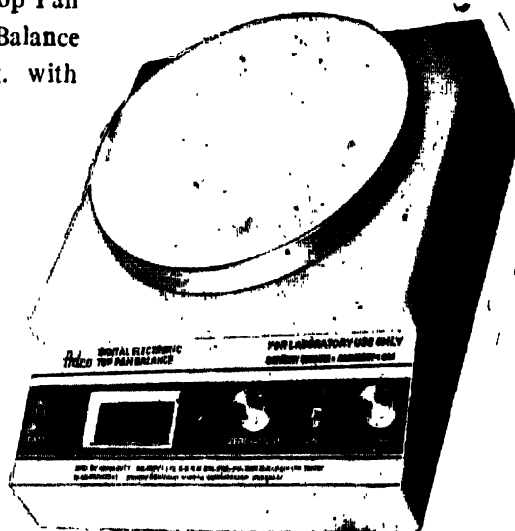
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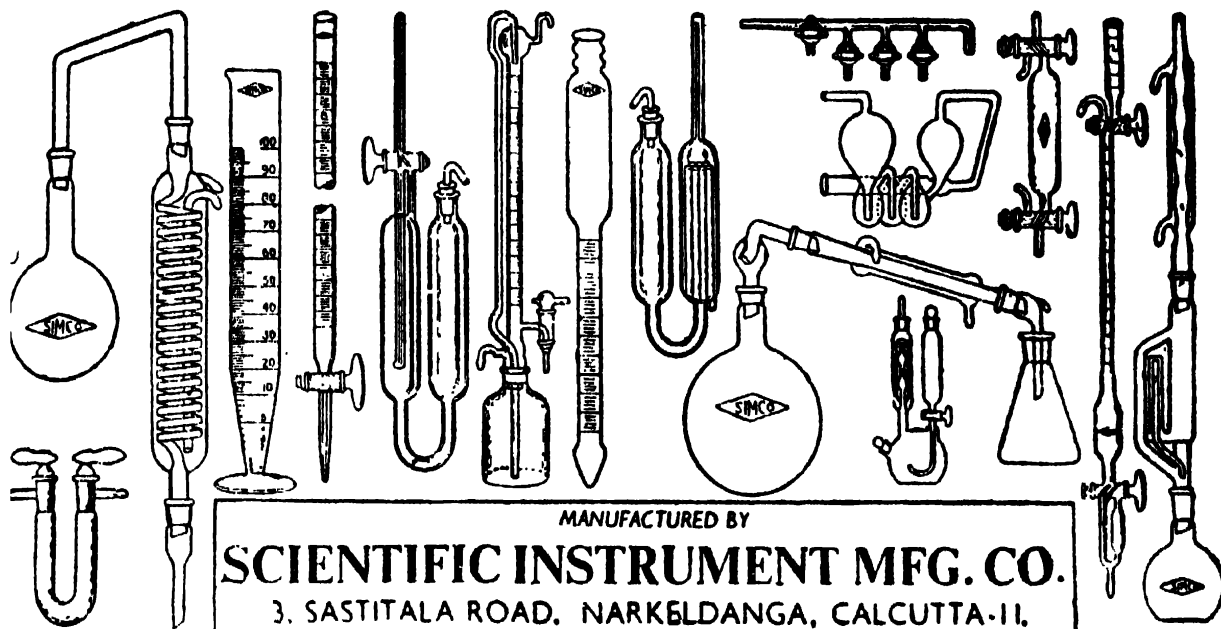
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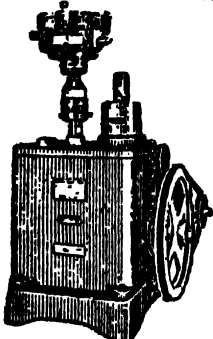

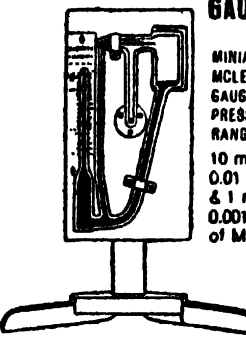
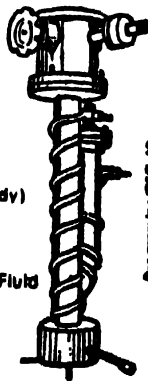
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SCIENCE & CULTURE

April 1987/Volume 53/Number 4

A MONTHLY JOURNAL OF NATURAL & CULTURAL SCIENCES

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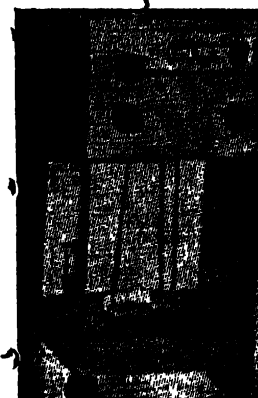
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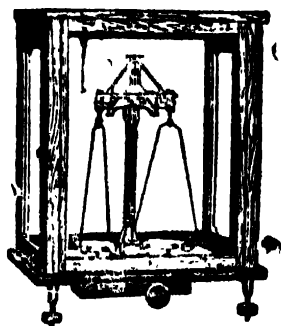


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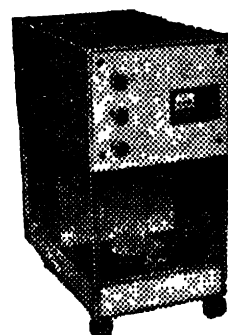
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PRESENT STATUS AND PROSPECTS IN IMPROVEMENT OF THE SUPPLY OF VEGETABLE OILS IN INDIA*

M. M. CHAKRABARTY

OILSEEDS constitute the second most important group of agricultural commodities in India occupying about 11 per cent of gross cropped area. The production of oil seeds has increased on an average at the rate of 2% annually during the 30 years of planning. Total oilseed production in lakh tonnes for the years 1980 to 1984 is included in (Table 1) from which it may be noted that the production of oilseeds was about 90 lakh tonnes in 1980-81 which increased by 30 lakh tonnes in 1981-82 and later showing somewhat less or a stagnant production.

The prime sources of oilseed production has been increase in area of cultivation specially of the major field crops like groundnut, rape and mustard, castor, sesame, niger, safflower, soybean and sunflower. Considerable increase in production of some of the oilseeds has been achieved to fulfill the target of the 6th plan.

However, inspite of such increase in production in some oilseeds, the position of India in the field of oils and fats has changed in the course of the past few decades from the status of the exporter of oils to a major importer instead. The situation has reached such a stage that India has no option but to continue to import oils quite substantially for a quite a long period.

Action Plan to Increase Vegetable Oil Resources by 2000 AD

Supply and Demand Projections¹

The supply and demand projections of vegetable oils are given in (Tables 2, 3 and 4).

It is clear that unless there is a significant breakthrough in oilseed production, the gap between demand and supply will mount to unacceptable levels, to the extent that the deficit cannot be met through imports and this will result in price increase of the edible oils.

To meet the deficit through indigenous oil supply will require a rate of growth of about 6 per cent a year from the current level of 2.5 per cent to achieve self-reliance by 2000 AD. Planning and implementation of schemes have to be taken up on war footing to realise the targets.

There is however some scope for optimism as the recent spurt in the interest on oilseed growth by ensuring higher annual outlays to research and development of oilseeds, active promotion by State Agricultural Departments in increasing area

*3rd Lecture delivered of the Agricultural Society of India on 28th August 1986 at the University College of Agriculture, Calcutta University as the 65th Birth-day Commemoration Lecture in honour of Prof. S. K. Mukherjee

under oilseed cultivation, introduction of new oilseed crops, increased seed distribution, subsidies etc. has resulted in an increase in oilseed production from an average of 89.6 lakh tonnes in the fifty five-year plan to 110 lakh tonnes during

the first four years of the sixth five year plan.

However an examination of the average yield of various oilseeds crops in India in comparison with their inherent yield potentials and highest yield observed elsewhere

TABLE 1 : Oilseeds Production Figures, 1980-84

Year	Total oilseed production in lakh tonnes
1980-81	90.69
1981-82	120.72
1982-83	106.00 (tentative)
1983-84	120.00

TABLE 2 : Supply & Demand Projections Till 2000 AD.

Year	Supply lakh tonnes	Demand (lakh tonnes) at 3.5% growth in national income	Demand (lakh tonnes) at 5% growth in national income
1985-86	35.58	44.43 (-8.85)	47.00 (-11.42)
1990-91	40.26	55.69 (-15.43)	64.70 (-24.44)
1995-96	45.55	69.80 (-24.25)	89.06 (-43.51)
2000-01	51.54	87.47 (-35.93)	122.59 (-71.05)

Figures in parentheses show deficit

TABLE 3: Future Strategy in Oilseed Development

Oil	Phase I (lakh tonnes)	Phase II
Soybean	3	
Groundnut	1	10
Rape/Mustard	1	2
Sunflower	4	—
Rice bran	3	3
Oil cake	2.5	1
Organised sector cultivation	—	3
Barter	2	1
	16.5	20

TABLE 4: Trends in Vegetable Oils Supply

Name of Oil	1950-51	1955-56	1960-61	1967-68	1970-71	1975-76	1980-81	1981-82	1982-83
Groundnut Oil	7.80	8.65	10.78	12.80	13.68	15.66	11.25	15.90	9.40
Solvent Extracted Oil			0.35	0.75	1.00	1.20	0.60	0.80	0.60
Rape & Mustard	2.13	2.40	3.76	4.13	5.47	4.70	6.27	7.36	6.30
Sesame Oil	1.33	1.40	0.95	1.34	1.70	1.40	1.32	1.50	1.10
Coconut Oil	1.00	1.20	1.30	1.50	1.50	1.50	1.80	1.80	1.80
Washed Cottonseed Oil			0.30	1.00	0.90	1.50	2.20	2.40	2.40
Safflower Oil	0.20	0.20	0.20		0.41	0.50	0.80	1.00	0.50
Niger Oil	0.25	0.25	0.25		0.45	0.50	0.33	0.35	0.30
Linseed Oil	1.06	1.21	1.15	1.15	1.30	1.80	1.24	1.32	1.10
Castor Oil	0.40	0.47	0.41	0.42	0.50	1.00	0.80	1.18	1.20
Ricebran and other minor Oils			0.20	0.30	0.50	1.30	2.56	3.15	3.50
Total local supply	14.17	15.78	19.65	23.39	27.41	31.06	23.17	36.76	28.20

*India***TABLE 5: Edible Oil Imports by Type¹***000 tonnes*

	Palm	Soya	Rape	Sunflower	Others	Total
1977/78	387	520	311	56	37	1311
1978/79	452	495	179	3	19	1148
1979/80	572	619	144	10	10	1355
1980/81	433	627	123	—	128	1311
1981/82	410	521	66	—	43	1040
1982/83	597	400	76	—	10	1083
1983/84	562	726	139	48	12	1487
1984/85	728	548	216	—	1	1493

in the world (Table 7) should give some confidence that technologies and management systems are available to increase the yield of most of these crops. An insight into the oilseed growth in the last 3 decades

reveal the stagnant position in area and production (Table 8). Oilseed crops have not received their due share of increase in area under irrigation and it is evident that irrigation alone is capable of doubling

yields. Some of the reasons which can be pointed out for poor yields of oilseeds are :

- lack of supply of quality seeds,
- being cultivation under rainfed conditions and under marginal and submarginal areas,

—being energy-rich crops need more energy inputs,

- mostly grown either as mixed crop or as intercrop with other major crops,
- infections and pests like rust, leaf spot alternaria, wilt etc.

TABLE 6 : India—Major Oilseed Crops in Seed Terms

000 tonnes	Groundnuts (Unshelled)	Sunflower seed	Soy-beans	Rape-seed	Sesame	Cottonseed
1975/76	6754	10	100	1936	470	2320
76/77	5264	20	135	1551	422	2060
77/78	6087	25	160	1630	520	2416
78/79	6209	30	294	1860	514	2698
79/80	5768	32	350	1428	348	2603
80/81	5006	66	442	2002	446	2397
81/82	7223	159	467	2382	590	2713
82/83	5283	230	491	2207	552	2562
83/84	7284	272	583	2566	618	2238
84/85	6714	360	930	3300	600	3150
85/86	5000	360	1100	3300	590	3000

TABLE 7 : Productivity Levels of Different Oilseeds in India and Abroad^{1,4}

Sl. No.	Crop	Average yield (kg/ha)	
		India	Abroad
1.	Groundnut	953	5784 (Israel)
2.	Rapeseed & Mustard	659	2826 (FR Germany)
3.	Sesame	283	2000 (Yugoslavia)
4.	Linseed	300	2000 (Newzealand)
5.	Castor	639	—
6.	Safflower	586	—
7.	Sunflower	407	2209 (Italy)
8.	Niger	294	—

TABLE 8 : Area, Production & Productivity of Oilseeds from 1951-52 to 1983-84

		Area — Production — Productivity —	'000 ha '000 tonnes kg/ha	
Crop		1951-52	1983-84	Increase/Decrease
Groundnut	Area	4917	7640	2713
	Production	3192	7284	4092
	Productivity	649	953	304
Rapeseed-Mustard	Area	2401	3892	1491
	Production	943	2565	1622
	Productivity	393	659	266
Sesame	Area	2405	2182	—223
	Production	452	618	166
	Productivity	188	283	95
Linseed	Area	1380	1466	86
	Production	333	440	107
	Productivity	241	300	59
Castor	Area	582	637	55
	Production	108	406	298
	Productivity	186	639	453
Safflower	Area	462	800	338
	Production	69	468	399
	Productivity	149	586	437
Niger	Area	522	595	73
	Production	91	175	84
	Productivity	173	294	121

Looking into the vast problems, the All India Coordinated Research Project on Oilseeds (AICORPO) was started in the year 1967 with the following main objectives :

- (1) Multi-disciplinary approach to problems.
- (2) Free exchange and flow of materials,

information, ideas among research workers.

- (3) Planning of technical programmes of research by common discussion and consent among the research workers.
- (4) Compulsory analysis, reporting and discussion of research results before the planting of following season crops.

The number of centres for different crops are groundnut (17), Rapeseed-Mustard (12), Sesame (9), Sunflower (3), Castor (7), Safflower (7), Linseed (7) and Niger (5). The project is assisted by Seven Project Coordinators located in the important areas of the respective crops.

<i>Crop Coordinator</i>	<i>Location</i>
Groundnut	PKV, Akola (Maharashtra)
Rapeseed-Mustard	HAU, Hissar (Haryana)
Sesame & Niger	JNKVV, Jabalpur (Madhya Pradesh)
Linseed	CSAUA & T, Kanpur (Uttar Pradesh)
Castor	DOR, Hyderabad (Andhra Pradesh)
Safflower	MPKV, Solapur (Maharashtra)
Sunflower	UAS, Bangalore (Karnataka)

I. RESEARCH ACHIEVEMENTS

The research progress made so far under different disciplines is as follows :

A. BREEDING :

The primary objective being to bring out genetic improvement in the material. The upto date list of total varieties released along with the newly released varieties is given in Table 9.

Major problems tackled are :

- (1) To stabilise the yield level.
- (2) To breed for physiologically efficient plant idcotypes.
- (3) To breed against important diseases and insect pests.
- (4) To breed for stress conditions.
- (5) To breed for different cropping systems.
- (6) Breeding for high oil content.
- (7) Development of hybrids.

B. AGRONOMY :

For all the oilseed crops, workable production technology like land preparation, time

TABLE 9 : Improved Varieties of Oilseed Crops

Crop	No. of varieties released	Recently released varieties
Groundnut	50	Chandra, GG-2, GG-1, G 201 (Kaushal), Jawan, Kadiri-3, JL-24 (Phule pragati), TC-17, UF 70-103.
Rapeseed-Mustard	37	Gobhi sarson Ludhiana 1, PT-303, RLM-619 Vardan (RK-1467), Vaibhav (RIC 1418).
Sesame	35	Haryana Til. 1, JT-7, T-13, Madhavi, Kanak, Kalika, Phule Til. 1, Gujrat Til. 1, Co. 1.
Linseed	16	Jawahar-23 (SPS-23-10), Garima (LHCK-39), Shubra (LHCK-21), Sweta (LHCK-31).
Niger	7	PGP-76 and N. 71
Safflower	16	A-1, Bhima, Manjira
Castor	10	Gauch-1, GCH-2
Sunflower	6	Morden, BSH-1.

TABLE 10 : Time of Sowing of Oilseed Crops

Sl. No.	Crop	Time of sowing
1.	Groundnut	First week of June to end of July
2.	Rapeseed-Mustard	Early Sept. to last week of November
3.	Sesame	First fortnight of May to end of July
4.	Safflower	Mid Sept. to mid October
5.	Linseed	First week of Oct. to second week of November
6.	Niger	Early June to end of August
7.	Castor	June to first fortnight of August
8.	Sunflower	June to end of August

TABLE 11 : Optimum Plant Population for Higher Yields of Oilseed Crops

Sl. No.	Crop		Seed rate kg/ha	Population '000/ha
1.	Groundnut	Bunch	100-110	333
		Spreading	90-100	222
2.	Rapeseed-Mustard		3-10	148 333
3.	Safflower		6-10	60-100
4.	Linseed		20-40	500
5.	Castor		12-15	55-66
6.	Sesame		2.5-3	222-333
7.	Niger		5-8	222 333
8.	Sunflower		8-10	55-74

of sowing, seed rate, plant population, seed treatment, fertiliser dose, irrigation requirement, weed control etc. have been evolved.

(i) *Time & Method of sowing :*

Since the major area under oilseeds is confined to rainfed conditions it is imperative to take advantage of limited periods of assured rains for establishing satisfactory plant stand and subsequent growth. By and large the beneficial effects of early sowing with the onset of monsoon for all the kharif oilseed crops were demonstrated. Time of sowing is still more critical in case of rabi oilseed crops as the crops

are grown under residual moisture conditions. In fact optimum time of sowing for different crops have been listed. Because of the fact that the sowing period is very much restricted in rainfed areas, effective methods of sowing to cover larger areas within a short span are required. Time of sowing for different oilseed crops is given in Table 10.

(ii) *Optimum plant populations :*

Optimum plant population is one of the important measure for higher yields. Gap filling in some of the oilseed crops especially groundnut is found to be of no use. The low seed rate hitherto

be followed are meant for assurance against complete crop failures in sub-normal seasons. Such a practice does not facilitate to exploit the yield potential under favourable seasons. However the optimum plant populations and seed rates are given in Table 11.

(iii) *Nutrient requirements :*

In systematic studies conducted to evaluate the relative contribution of different components of improved crop production technology, the beneficial effects of fertilizer application were more conspicuous. The requirement of major nutrients for each oilseed crop varies depending on soil type and cropping system. The recommended rate of fertilizers has been given in Table 12 for different oilseed crops.

The oilseed crops particularly groundnut responded to the application of sulphur, calcium and micro-nutrients like boron, iron, copper and molybdenum. A specific combination of sulphur, zinc and boron significantly increased the mustard yield at Durgapura in Rajasthan. The spray schedule for micro-nutrient deficiency control in groundnut is given in Table 13

(iv) *Weed control :*

Weeds were found to reduce the yields of oilseed crops significantly. Apart from reducing yields they may also harbour some insect and pests. In general it is recommended to keep the field clean till first 45 days of crop growth for all oilseed crops. Keeping in mind the increase in labour costs and mechanisation in farming systematic studies on herbicidal control at different research centres on many of the oilseed crops have been initiated. The herbicides and their dose have been given in Table 14 for use in groundnut.

Relevance and effectivity of the research results when used on large scale has been engaging the attention of oilseed workers. Experiments have proved that if the farmers adopt the improved package of practices the production of oilseeds can go up considerably. The factors that play a critical role in production have also been identified. Among the individual factors of production the most critical factors identified in order of merit are given below.

- (i) Improved variety
- (ii) Plant population
- (iii) Fertilizer application
- (iv) Plant protection

C. ECONOMICALLY IMPORTANT INSECTS & DISEASES

Crop	Insects	Diseases
Groundnut	Leaf minor, Red hairy caterpillar & white grub	Cercospora leaf spot, Rust Bud necrosis & Aflatoxin.
Rapeseed-Mustard	Aphids & Painted bug	Alternaria, white Rust, Downey mildew.
Sesame	Leaf roller, capsule borer and hairy caterpillar	Phyllody, Stem & root rot, Cercospora leaf spot & Powdery mildew.
Linseed	Bud fly	Rust, fusarium wilt, leaf-blight.
Castor	Castor semilooper & capsule borer	Alternaria leaf spot, bacterial leaf spot, fusarium wilt.
Niger		Alternaria & Cercospora leaf-spot.
Safflower	Aphid	Leaf spot and fusarium wilt.
Sunflower	Caterpillar	Alternaria leaf blight and Head rot.

TABLE 12: Fertilizer Requirements of Various Oilseed Crops

S. No.	Crop	Active nutrient (kg/ha)		
		N	P	K
1	Groundnut (rainfed)	10-20	40-80	0-45
	.. (irrigated)	10-30	40-80	0-66
2.	Rapeseed-Mustard (rainfed)	20-60	20-30	10-20
	.. (irrigated)	50-120	30-50	20-40
3.	Sesame	20-40	10-30	0-20
4.	Safflower	25-50	25-30	—
5	Linseed	40-50	20-25	—
6	Castor	20-40	20-40	10-30
7.	Niger	10-20	10-20	0-20
8.	Sunflower (rainfed)	20-40	30-50	30-40
	.. (irrigated)	30-60	30-90	30-60

TABLE 13: Schedule for Controlling Micronutrient Deficiencies

Nutrient	Form & rate of application to soil kg/ha	Spray schedule
Boron	Borax, 5-20	0.2% Borax.
Copper	Copper sulphate 10-50	0.1% Copper sulphate + 0.5% lime.
Manganese	Manganese sulphate 10-50	0.6% Manganese sulphate + 0.3% lime.
Zinc	Zinc sulphate 10-50	0.5% Zinc sulphate + 0.25% lime
Molybdenum	Sodium molybdate 15-500 g/ha	0.5% Sodium—molybdate
Iron	Ferrous sulphate 10	0.15% solution of Ferrous sulphate with 0.015% citric acid.

Bye Product and Other Oils

(a) *Rice bran* :

Out of the 118 million tonnes of paddy produced, 35 million tonnes is hand pounded. Balance about 83 million tonnes of paddy, assuming about 7 per cent bran, will yield 5.8 million of bran which in turn will give about 6 lakh tonnes of oil. Of this bran only about 50 per cent is obtained

through shellers and used for oil extraction. The huller bran obviously is not suitable for oil extraction because of poor oil content. Simple modification of the hullers to enable production of bran with higher oil content (10-12%) could yield an additional 3 lakh tonnes of the oil. Institutions connected with rice milling should be actively encouraged to come out with simple modifications on the huller mills at a nominal cost of say

TABLE 14 : Chemical weed control in groundnut

Herbicides	Rate a.i. kg/ha	Time of application & precautions
Fluchloralin (Basalin)	1.25-1.50	Pre sowing incorporation into soil
Nitrogen (Tok)	1.50-2.00	Pre emergence to crop & weed
Penodimethalin (Stomp)	0.60-1.50	—do—
Alachlor (Lasso)	1.50-2.00	—do—
Oxyfluorfen (Goal)	0.25-0.50	—do—

Rs. 3,000/- and thus enable the miller to utilise the existing huller to better realisation. If paddy production is slated for an increase to 150 million tonnes by 2000 AD, the further additional oil potential is about 4 lakh tonnes.

(b) *Palm/coconut :*

Malaysia has obtained spectacular yields for palm. The suitable areas for cultivation in India are Kerala and Andaman/Nicobar Islands. The area under cultivation is about 8,800 hectares. Any effort to bring in a plantation approach with high yielding clonal palm varieties would pay rich dividends. This in addition will give us palm kernel oil which is a good substitute for coconut oil.

Coconut suffers from obsolescence. The possibility of coconut plantation as agri-business would certainly raise productivity. The tissue culture method of building high yielding, pest resistant varieties need to be explored with greater vigour. The coconut oil is unique in its applications, for direct consumption as well as for industrial use, and there is no clearcut substitute as yet. So there is a need to revive this crop. There is a great scope for intercropping of coconut with other crops say spices.

(c) *Development package :*

Apart from giving high yielding seeds, it is very important to use it productively.

Adequate quantities of high yielding seeds have to be given to the farmers at the appropriate time. Also, there is a lack of organised seed storage and management system which affects the crop growth through a patchy stand of the crop and this is particularly so for oilseed crop. The yields are often affected to the extent of 20-25%. The organisation needs to be strengthened so that the farmers get good quality seed supplies on time at a cost not beyond their reach.

(d) *Oil from oilcake :*

Most of the edible oilcakes are solvent extracted and the oils obtained therefrom are used for consumption or industrial purposes depending on quality. It is essential to make a systematic survey of the oilcake availability, the quantity of edible as well as nonedible oilcakes which go unextracted. Further, Government should bring in policies which will ensure that oilcakes, whether edible or nonedible grade, from whichever oil bearing material, are solvent extracted to augment the overall supplies of oils. There is great potential for recovery of oil from this source and this needs to be quantitated and pursued. Approximately this would give 2.5 lakh tonnes of additional oil. Further, the increased productivity of the various oilseeds would give additional oilcake which would result in extra 1 lakh tone oil.

If the above suggestions are implemented

with appropriate incentives, it may not be difficult to achieve the targets in 2000 AD. The future strategy in development of oilseeds and other resources may be split into two phases ; short term (Phase I) and long term (Phase II) as given in Table 3.

Keeping in view of the above strategies for oilseed development in future, the following recommendations may be made for augmenting oils and fats resources :

—As a major oilseed crop, groundnut should receive maximum attention followed by rape/mustard, soybean, safflower, sunflower, niger.

Monetary encouragement is necessary for a fresh cropping of coconut. Here a plantation approach and innovative tissue culture would fare well.

—Forest oilseeds collection such as sal, mowrah, needs to be intensified, keeping in mind the ecology aspect. The potential is as high as 15 million tonnes equivalent to 2 million tonnes of oils and fats. Newer resources need exploration.

Area of least productivity for sugarcane must be given for growing the nutritionally superior oilseed crop.

—Genetic engineering in oilseeds development needs to be encouraged as advancement in this field has led to the development of canola oil from of nutritionally not desirable glucosinolates and erucic acid.

—Organised sector involved in processing of oils should be encouraged to grow their own raw material on fallow lands in a time bound programme over a five-year period.

—Provision for larger participation by the industry, scientists and technologists in the National Oilseeds and Vegetable Oils Development Board for more effective result-oriented planning should be made.

Substantial funds should be allocated

for oilseeds extension, research and development in the Seventh Five-Year Plan ; the higher plan outlay could come from increasing the release price of half a million tonnes of imported oil to the vanaspati industry.

—Import-export of oils or even oilseeds should be on a planned basis and long term planning on buying, processing and integrating of imported oils, type and quantity inclusive, into the national system is needed.

—A two-tier pricing system for imported oils should become operative. For the affluent, market systems would operate. For the deprived economic sections, use of small packs at a subsidised price through the public distribution system should be introduced.

Plant Geneticists' contribution towards the development of new type of natural fats

Nature has been always very generous in producing multitude of oilseeds having diverse nature of fatty acids, triglycerides and unsaponifiable favour components with pigments, antioxidant, vitamins etc. Depending on the fatty acid profile, glyceride structure and the composition of the non-triglycerides the various oils and fats have distinct edible and industrial applications.

However, it should be stated that certain oils having use in frying medium in some countries are considered unfit for consumption in many countries due to certain biological implications.

Mention may be made of erucic acid-rich rapeseed oil containing allyl isothiocyanates as well. The biochemical investigations claim that high erucic acid-rich oils have adverse effects, when fed in a large proportion as a diet to animals and cause cardiomyopathy and later myocardial changes occur. This study has shown that the level of erucic acid above 6 per cent to dietary

calories promote definite lipidosis in the rat myocardium.

Soybean oil, because it contains 7-10 per cent linolenic acid, has a problem of storage as this acid is believed to be involved due to a flavour problem. Safflower oil, owing to its having very high linoleic acid content, is good for people with cholesterol problem. However, such high linoleic acid rich oil in a frying medium does not appear to be very stable and is likely to be involved in the formation of lipid molecules that may be highly mutagenic. Cottonseed oil contains gossypol that is responsible for dark colour content of cottonseed oil and toxicity when used in animal nutrition. This gossypol remains in the meal also after extraction of oil.

All the above biochemical problems associated with the lipid and non-lipids of some specific oils have led to very extensive research programs in developing the concerned oil seeds with complete elimination or with much reduced problem.

The Plant Geneticists have contributed enormously in these areas in developing now variety of oilseeds having altogether different nature of oil and non-oil constituents. The entire approach is based on the manipulation of the genes or the genetic innovation.

The Plant Geneticists have developed practically zero erucic acid variety of rapeseed oil and also very low content of flavour component, the allyl isothiocyanates. Table 15 shows the fatty acid profile of high

erucic acid and low erucic acid rapeseed oils.

By genetic manipulation, it has been also possible to produce very high erucic acid rich rapeseed oil for industrial utilisation of erucic acid. It is also interesting to mention here that Downey *et al.* have reported very recently that by biotechnological manipulation rapeseed oil having high linoleic content about 30 per cent and with much reduced linoleic acid about 3 per cent can be developed so that rapeseed oil can be very close to soybean oil in respect to fatty acid composition. It is reported by the same authors that rapeseed appears to be more responsible to the biotechnological manipulation with instant inbred plant being produced routinely from the cultivating of anthers and microspores, while fusing of protoplasts to combine desirable cytoplasmic traits from one parent with the nuclear or cytoplasmic characteristics of entirely new oil-seeds having new natural oil composition.

Knowles has been able to produce safflower oil having high oleic acid by genetic manipulation. He has been able to identify the major genetic *locus ol* which governs the proportion of oleic and linoleic acid with the genotype *olol* having 72-80 per cent oleic acid in safflower-seed oil and the genotype *olol* 72-80 per cent linoleic acid. The fatty acid profile of some introduction and selection of safflower-seed oil are shown in Table 16. It may be noted from the slide that two varieties of safflowerseed could be pro-

TABLE 15 : Fatty acid composition of high erucic and low erucic rapeseed oil^a

	C _{14:0}	C _{16:0}	C _{16:1}	C _{18:0}	C _{18:1}	C _{18:2}	C _{18:3}	C _{20:0}	C _{20:1}	C _{22:0}	C ₂₂	C _{24:0}
Low Erucic Acid	0.2	2.5	0.6	0.9	50	18	6	0.1	0.1	0.5	5.0	0.2
		6.0		2.1	66	30	14	1.2	4.3			
High Erucic Acid		2	—	2	34	17	7	—	9		26	

TABLE 16 : Fatty acid composition of some introductions and selections of safflower

UC designation or variety name	Fatty acid composition			
	Palmitic	Stearic	Oleic	Linoleic
India 65 204	6.5	2.7	31.6	59.2
India 65-246	6.7	1.9	24.6	66.8
India 65-465	6.4	1.7	25.3	66.6
Australian introduction	7.6	1.0	28.3	63.1
US-10 selection	7.5	2.1	25.8	64.6
US-10, high linoleic	7.9	2.4	17.9	71.8
UC-1, high oleic	5.9	1.6	78.8	13.7

TABLE 17 : Fatty acid distributions in sunflower oils from various sources and varieties

Fatty Acid	Weight per cent								
	Russian variety			American variety			Canadian variety		
	a	b	c	d	e	f	g	h	i
14 : 0	0.2	0.1	0.1	0.1	—	—	—	0.1	0.2
16 : 0	6.0	6.2	5.5	6.1	5.9	5.2	6.1	6.2	7.0
16 : 1	0.1	0.1	0.1	0.1	—	—	—	0.2	0.1
17 : 0	tr	tr	tr	tr	—	—	—	0.1	—
17 : 1	—	—	tr	—	—	—	—	tr	—
18 : 0	5.6	4.4	4.7	4.2	4.7	4.4	3.7	4.6	4.0
18 : 1	17.8	17.0	19.5	14.9	26.4	50.9	16.4	26.4	31.5
18 : 2	68.7	71.1	68.6	73.5	61.5	37.9	73.7	61.0	65.9
18 : 3	0.2	0.1	0.1	0.2	—	—	—	0.1	0.2
20 : 0	0.3	0.2	0.3	0.2	0.5	0.5	—	0.5	0.6
20 : 1	0.1	tr	0.1	—	—	—	—	—	—
22 : 0	0.8	0.8	0.9	0.7	0.7	0.7	—	0.5	tr
22 : 1	—	—	—	—	—	—	—	0.3	0.5
24 : 0	0.1	tr	0.2	—	—	—	—	—	—

a — Armavirec, b — 8931 VNIMK, c — Mingreen, d — Sample from Minnesota Linseed Oil Co. of 1968 production, e — Variety grown in Minnesota, f — Variety grown in Texas, g — Russian variety 'Peredovnik', grown in Canada mean value of oil from 1964 seed from 10 locations.

duced one having high linoleic acid and another having high oleic acid.

It has been possible to modify sunflower oil by appropriate breeding method. Considerable changes in the gross chemical composition of the seed has been effected. Russian workers were able to increase the oil content of the seed from 35 to 50 per cent thus increasing the average yield of edible, product per acre by 30 per cent or more by taking advantages of controlled hybrids and by breeding for control of pests. With controlled environment the following range oil compositions can be produced, namely saturated fatty acid 8 to 40 oleic acid 12 to 66 per cent and linoleic acid 25 to 80 per cent. The fatty acid composition of different varieties of sunflower seed can be seen from Table 17 that linoleic acid can be varied from about 38 per cent to as high as to about 74 per cent with corresponding oleic acid from

about 15 per cent to as high as 51 per cent.

Soybean oil has been also studied quite extensively to alter its fatty acid profile by genetic manipulation in soybean oil-seed crop. The primary objective of genetic manipulation is to produce soybean oil with much lower concentration of linolenic acid that is implicated with off flavour of the oil.

A very recent report indicates that germ-plasms for the desired trait for zero or low linolenic can be available. A selection (N 84-6002) from the progeny of germ-plasm contains 3.5 ± 0.50 per cent linolenic acid when grown in several environments. There is also increasing protein content in the seed.

A variation in fatty acid profile in different genetically bred soyaseed oil is shown in Table 18.

TABLE 18 : Fatty acid distribution for some commercial and experimental soybean oils reported during the period 1965-1976 (166 475, 478, 479)

Fatty acid	Weight per cent					
	Commercial oil			Experimental oil		
	(478)	(166)	(479) ^a	(479) ^b	(475) ^c	(475) ^d
12:0	tr	—	—	—	—	—
14:0	0.1	—	—	—	—	—
15:0	tr	—	—	—	—	—
16:0	0.5	12.0	—	—	—	—
16:1	tr	0.5	—	—	—	—
17:0	tr	—	—	—	—	—
18:0	3.2	3.6	—	—	—	—
18:1	22.3	23.7	42.0	32.8	37.5	36.9
18:2	54.4	51.4	38.3	46.4	44.2	48.5
18:3	8.3	8.8	42.8	7.0	4.0	5.5
20:0	0.2	—	—	—	—	—
20:1	0.9	—	—	—	—	—

a. Genotype selection F₄ from PI 90, 406 and PI 92, 567

b. Parent PI 90, 406 genotype

c. Grown at Tifton Ga average daily summer temperature 78°F, 16.9 in of rain 1973, Group A.

d. Grown at Blairsville, Ga., average daily summer temperature 64.5°F, 27.2 in of rain, 1973, Group a.

TABLE 19 : Fatty acid composition of cottonseed oil varieties in India

Sl. No.	Variety	C _{11:0}	C _{14:0}	C _{16:0}	C _{18:0}	C _{20:0}	C _{22:0}	C _{18:1}	C _{18:2}	C.P.A.
1.	Giza-7	0.7	29.9	2.5	0.3	0.5	17.7	47.6	0.8	
2.	Varalaxmi	1.2	28.9	2.8	0.3	0.4	15.0	50.5	0.9	
3.	CBS 156	1.9	23.2	5.2	0.3	0.4	20.9	47.2	0.9	
4.	Hybrid-5	2.2	26.7	3.2	0.3	0.4	15.9	50.2	1.1	
5.	Laxmi	1.2	26.7	2.9	0.3	0.4	17.4	50.3	0.9	
6.	NHY-12	1.2	25.5	3.4	0.3	0.4	18.0	50.5	0.8	
7.	Hybrid-4	0.3	27.1	3.4	0.3	0.4	14.1	53.8	0.6	

Cottonseed oil is characterised by a phenolic component gossypol which is well-known to be responsible for the troublesome dark colour of cottonseed oil; it causes discoloration of the egg when used as feed and also creates metabolic disturbance when fed to non-ruminant animals in excessive amounts. Plant geneticists have also succeeded in developing glandless cottonseed oil which is essentially free from gossypol.

A lot of genetic research has been in progress to produce cottonseed with low gossypol content or free of gossypol. Gossypol is contained in pigment glands present in the cottonseed kernel. Glandless cottonseeds are essentially free from gossypol and produce very light colour crude oil or meal.

A number of cotton-seed variety has also been developed in India whose composition is shown in Table 19.

The elimination of gossypol from oilseed and the variation of fatty acid composition in oil have led to the utilisation of cottonseed oil as food fat and also food application of defatted and protein rich isolate which is now being used in human nutrition.

In recent years successful results have been obtained by using biotechnological methods such as tissue culture. Dr. A. T.

James of Unilever Research has used plant cell cultures for plant multiplication of selected premium oil-yielding plants for improving agricultural production. While the cost per plant rules out the annual crops such as rape and soybean, perennial crops such as coconut and oil palm are amenable. Both crops are propagated by seeds and since the seed is derived from parents not inbred to stable but the progeny are highly variable. James has been successful in developing selected oil palm by this method. Tissue from the chosen plant (that are already growing in a plantation with consistent higher yield, response to fertilizers etc.) is disinfected and put into a defined growth medium. The tissue respond by producing cells known as callus that grow moderately rapidly and can be multiplied up to any desired scale by detaching pieces and subculturing. By appropriate change in the culture medium, these cells can be encouraged to produce compact cell masses (called embryoid) that closely resemble the normal embryo from the seeds. The embryoids will also multiply indefinitely under the correct conditions and can then be induced to form roots and shoots and hence small viable plants. Each of these plants is genetically identical to the parent plant from which the original piece of tissue was obtained (a clone). It was initially possi-

ble to increase the yield of palm oil from 6 tonnes/ha to 8 tonnes/ha in Malaysian palm plantations. The present indications are that the yield of up to 10 tonnes/ha is possible. The unexpected additional advantages have emerged (a) a considerable variation in fatty acid composition between clones and (b) a considerable variation in carotenoid contents between clones. It has been possible to produce, apart from those giving the conventional palm oil, others that give a higher oleic level, or a higher palmitic level, or a higher linoleic level. This gives the growers the possibility of more specialised oils as well as conventional palm oils. The higher cost of tissue cultures compared with conventional seeds is soon recovered in 2 years so that in the next 20 years the growers reap a major benefit. The same approach is being taken with coconut palm and one would hope the similar advantages. A new dimension has been added by the ability of genetic engineering to change the protein, carbo-

hydrate and fat composition of major oil-seeds towards the composition required by the end users.

All these would result ultimately in requiring less processing for human use and better seed proteins for both the animal feed and human food industries.

Projected World Biotechnology Product Sales (1988-1990)¹

Product	Billion US \$
Energy	9.4
Agriculture	5.7
Food	3.7
Drugs	2.9
Plastics	2.6
Chemicals	2.5
Others	0.3
Total	27.1

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NOTES & NEWS

Largest groundnut producer

India has emerged as the largest groundnut producer in the world, with the acreage under it nearly trebling from 462,000 ha in 1975-76 to 12,27,000 ha in 1984-85. The productivity of groundnut, which is taken in both the kharif and rabi seasons, can be doubled to 3,000 kg/ha in the rabi season with the help of proper technologies.

At present, the cultivation of rabi groundnut is confined to six States—Gujarat, Maharashtra, Karnataka, Tamil Nadu, Andhra Pradesh and Orissa. Of late, the practice is slowly catching up in the Chhattisgarh area of Madhya Pradesh. The present area under rabi groundnut accounts for about 16% of the total groundnut area and contributes about 28% of the total production.

The proper technologies, according to a booklet published by the technology mission for augmenting the oilseed production in the country, include selection of proper soil, sowing at appropriate time, preparation of seed-bed, choice of good variety of seed, application of rhizobial culture and NPK fertilisers, weed control and irrigation. □

The Statesman

Role of cameloids

Throughout the Central Andean region, the conviction is fast growing that the only way to contain and reverse desertification in the vulnerable highlands is by replacing sheep with cameloids. This is the view of Julio Sumar of the La Raya research station in Cuzco, the ancient capital of the Incas. At least two other institutions in Peru—one set up by Puno University near Lake Titicaca

and the other at the University of Lima—have also recently launched research and development programmes. Much of Peru's population lives in the sprawling grasslands of the Andes, the majority of them at altitudes where the perpetual cold inhibits growth of crops and trees. But the runty remnants of sheep—some brought in by the conquistadors, others more recent imports—yield little milk and poor meat. The sheep are also denuding the fragile pastures at an alarming rate and desertification is spreading in several areas. On the other hand, the cameloids, whose abilities to reproduce at altitudes as high as 5,500 m, where neither sheep nor human beings can survive, has attracted international researchers of other disciplines to the high Andes.

La Raya was set up in 1945 by the Lima-based San Marcos University's Faculty of Veterinary Medicine, being some three day's journey by road from the Peruvian Capital. It has a four-pronged integrated programme to multiply cameloids and improve their health: disease control, nutrition change, reproduction enhancement and general management. The station's work has been particularly significant, since Peru's cameloid stocks were decimated in the first half of the seventies by large landowners. The populations of the two domesticated species of the genus *Lama*, the llama (*L. grama*) and alpaca (*L. pacos*) have now both doubled to 1.0 and 2.5 millions respectively in the past ten years.

Peru also has some 100,000 vicunas (*L. vicugna*) in the wild. "This beautiful, gazelle-like creature was once hunted to the point of extinction", Sumar stated. "But it is thriving again and with good management practices can now be systematically culled males only, for their flesh and fine wool. The fourth cameloid (*L. huanacus*) is important in Argentina and Chile and less so in Bolivia and Peru.

These four countries share the native habitat of the cameloids—some 30 million ha of natural pasture in the Central Andean

high-lands. Roughly two-thirds of this rangeland and some 60% of the world's alpacas and llamas are in Peru. Perhaps 30% are in Bolivia and Argentina and Chile have the rest.

Within the constraints of topography and climate, economic hope for the population of this region lies almost exclusively in livestock and the only viable animals here are the cameloids. Julio Sumar's special task is to improve cameloid reproductivity. Radio isotopes are being applied—to blood, milk and other samples in laboratories, never on the animals themselves—to discover the secrets of cameloid hormonal behaviour which other methods could not reveal. Most of the research is now focused on post-conception hormonal activity in pregnant cameloids. This is a crucial area because an estimated 50% of embryos die in the first month of gestation, a phenomenon coupled with the production of hormones. If science is to intervene to improve the pregnancy/delivery ratio, intricate details of the animals' normal physiology must be determined.

"But reproductivity is also dependent on nutrition and good health," Sumar pointed out. Three diseases were identified early—a diarrhoea caused by a bacterium *Clostridium perfringens*; an external disease called mange, caused by the parasite *Sarcoptes scabiei*; pneumonia, which is really a group of diseases caused by the cold as much as by parasites. A vaccine against the diarrhoea has now been developed and taken to the field by La Raya technicians. It is administered to pregnant animals, transferring antibodies from mother to foetus to calf. Mange is also being successfully treated with baths and dips. The Incas knew of mange and had a strict rule that any afflicted animal was to be killed and buried deep, which seems to have been sufficient to control it. But, as Sumar mentioned, it cannot be applied today, "because even diseased animals are important to these poor people." Counter-

measures against pneumonia consist essentially in improving resistance by better feeding and management. Better nutrition means improving the quality and quantity of natural forage, because concentrates and stall-feeding are neither affordable nor practicable. Three methods are being used to improve land productivity:

—irrigation, principally restoring the derelict Inca canal networks to distribute water from mountain snow and river sources;

—rotational grazing, using fences (for which the government pays the farmers directly) to keep parts of the range fallow for long periods;

—seeding with native grass, rye grass imported from New Zealand and a clover-like legume from Chile.

For all these activities, the peasants provide free labour, while the station offers the seeds, tools and advice. Other improvements include hand-shears and mechanical shearing to replace the broken glass and assortment of knives previously used; more methodical weaning of the calves, mainly to encourage the next pregnancy; improvement of the stock generally, by careful culling of inadequate males.

Perhaps the station's greatest success is that the campesinos are now very much involved in the project. These people know the importance of cameloids, admitted Sumar. "Cameloids treat the plants and the soil like, as we say, a lady. They have soft padded feet and graze with a grace. They utilise the extremely poor high-land forage with very high efficiency. They provide high-value wool for export, excellent fat-free meat, hides for a variety of local uses. Their faeces are a good energy source in this area where trees do not grow and additionally, the llama is a beast of burden.

"Now look at the sheep with their hard hooves and voracious appetites. They shocked the Incas when they first brought in by the Spanish conquerors. When the Incas saw them, they said, "This animal has

the mouth and feet of the devil "and they were right." □

Ceres

Death trap for birds

A natural death trap for birds similar to the Jatinga mystery in Assam has recently been found by bird-watchers and ornithologists of the Bombay Natural History Society.

Located atop the funnel-shaped valley in Murabad taluk of Thane district in Maharashtra, the Malshej Ghat, nestled at an altitude of 750 m, is a natural death trap for various species of birds.

The birds roosting around the area covered with deciduous forests are found to be entrapped by a peculiar phenomenon comprising high-velocity winds, heavy mist and fog and eventually die.

Bird-watchers noticed that the phenomenon occurred every year during June-July and took a heavy toll of different species of bird life. The phenomenon which continues for several weeks, blinds and disorients the birds faced with high-velocity winds (80 km/hr) accompanied by fog and drizzle, forcing them to the only source of light—the Malshej Ghat resthouse of the Maharashtra Tourist Development—apparently to seek refuge and fight against the closed glass-panes and ultimately smash themselves to death. □

The Statesman

More than a nut

The poisonous Barbados nut (*Jatropha curcas* L.), just a little bigger than a hazelnut (*Corylus americana* Walt.) could

turn out to be packed with promise for mankind. You can use it to make soap, light your home, treat constipation, fuel fires and fertilise the soil. But West German researchers have just discovered an even more revolutionary use for it—fuelling the internal combustion engine. Engineers working for the Eschborn-based West German foreign aid agency GTZ has proved this amazing property of the nut in a field project on Cape Verde, Senegal. The objective is not to rob OPEC but to help poor nations unable to afford imported energy. As you would not dress your salad in the oil, Barbados-nut crops could offer poor farmers a new source of income without perturbing present world markets in edible oils.

The Barbados-nut has a long history as a laxative and is called the purgative nut in some languages. A shrub found up to 6 m tall in several of the world's tropical countries, the plant does not need to be fenced off either. Not even goats will touch it due to its nasty latex. The shrub can be planted in the open to stop soil erosion.

The GTZ set about checking out the fuel potential of the nut in 1985, awarding an engineering firm a contract to adopt a motor to run on Barbados-nut oil. Seven tons of nuts were shipped to West Germany for experimentation. At the end of 1986, the firm proudly unveiled the first working nut-oil engines. One has been placed into operation at Cape Verde, driving a generator. Two more are about to be put to use, providing power for an electric water pump and for an ice-making machine. Cape Verde fishermen will be able to bring fresh fish to market in the ice.

The motors are adapted diesel engines, holding out the promise of lower foreign exchange for African and Latin American nations without oil-wells and with plenty of land to raise nuts. □

S. C. Datta

LETTERS TO THE EDITOR

Intestinal lymphangiectasia in chicks artificially infected by the nematode *Ascaridia galli* (Schränk' 1788)

Chicks were artificially infected with *Ascaridia galli* (Schränk' 1788) by the method of Reidel⁶ to study the histopathogenicity of the nematode.

Fifty adult chicks were given 100 gms of Mebendazole twice daily for three consecutive days to remove helminth parasites. After five days faecal sampling was done to confirm that the chicks were free from helminthic infections. Fortyfive chicks were infected with 250 eggs of *A. galli* each whereas five chicks were kept as control. The infected and control chicks were dissected after 30 days and their intestines were fixed in aqueous Bouin's

fixative for microtomy. The infection of *A. galli* was seen 100% in experimentally infected chicks. Both the groups of chicks were given the same living conditions and food but were kept in separate cages.

A. galli was seen attached to the intestinal wall in intervillous space, compressing the adjacent villi (Fig. 1). The cells of the compressed adjacent villi became square to rectangular with nuclei shifted to various unusual positions. It was also observed that the intestinal chyle vessels were dilated in the nematode-infected chicks (Fig. 1). The villi were deformed due to distended chyle vessels specially at the tip (Fig. 1). This condition resembles intestinal lymphangiectasia of man and cattle (Waldmann⁵ and Nielsen and Andersen⁴). At several places in infected chicks, leaks were seen at intercellular junctions of intestinal mucosal epithelial cells. Murray¹ and Murray *et al.*^{2,3} have also observed intercellular lesions in cattle with ostergiasis and in rats infected with *Nippostrongylus brasiliensis*. The authors believe that the leaks in the mucosal epithelium were formed to drain out the lymph released due to rupture of chyle vessels.

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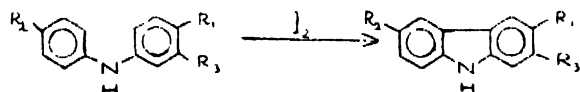
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Fig. 1

Iodine Catalysed Thermal Beckmann Rearrangement: Benzanilide from Benzophenone oxime

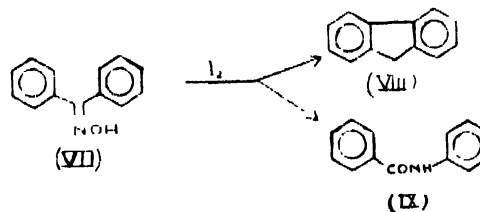
Iodine catalysed cyclisation at elevated temperature leading to the synthesis of carbazoles¹⁻⁸ (IV-VI) from appropriately substituted diphenylamines (I-III) involve a new carbon-carbon bond formation through hydrogen abstraction and radical formation⁴. Our interest in the synthesis of phenanthridones which could be carried out by Beckmann rearrangement of fluorenone oxime, prompted us to undertake iodine catalysed cyclisation reaction of benzophenone oxime to obtain fluorenone oxime by hydrogen abstraction and new carbon-carbon bond formation. The oxime, so obtained could be used for phenanthridone synthesis. In such attempts we have observed that an unprecedented Beckmann transformation under the thermal condition of the experiment takes place in addition to the formation of a new carbon-carbon bond leading to the formation of benzanilide, fluorene and other products. In the present communication we report our preliminary results on the formation of benzanilide and fluorene.



- (I) $R_1 = R_2 = R_3 = H$
- (II) $R_1 = CH_3$; $R_2 = OCH_3$
- (III) $R_1 = CH_3$; $R_2 = R_3 = OCH_3$
- (IV) $R_1 = R_2 = R_3 = H$
- (V) $R_1 = CH_3$; $R_2 = OCH_3$
- (VI) $R_1 = CH_3$; $R_2 = R_3 = OCH_3$

Benzophenone oxime, m.p. 140° (VII) and a small quantity of iodine were heated in a sealed tube at 200-500°C for half an hour. The reaction product was dissolved in chloroform and chromatographed over alumina (E. Merck). From the yellow petroleum ether eluates several products could be detected by T. L. C. One of these products, $C_{18}H_{10}$, m.p. 116°, showed UV absorption spectrum at λ_{max} 300, 290 nm (Log ϵ 4.30, 3.8), very similar to that of fluorene. This was also con-

firmed by its IR spectrum ν_{max} 1550, 1580 cm^{-1} (aromatic system). The compound so obtained was identified as fluorene.



From the benzene eluates, a colourless product $C_{18}H_{11}NO$, m.p. 161°, λ_{max} 262 nm (log ϵ 3.4), ν_{max} 3300 (-NH-function), 720, 1670 cm^{-1} (monosubstituted benzene derivative) could be obtained. These data indicated the compound to be benzanilide which was confirmed by its comparison with a pure specimen of benzanilide (m.p., TLC, IR, uv).

Iodine catalysed thermal Beckmann rearrangement appears to have no precedence, though in 1957 Tokura *et al.*⁶ reported that ketoximes undergo Beckmann rearrangements in liquid sulphur dioxide with bromine and iodine. The detailed discussion on this thermal Beckmann transformation will be reported along with further results of our experiments in a future publication.

Authors thank the Chairman, Dept. of Chemistry and the Director, Bose Institute for their interests.

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Response of kew pineapple to plant densities and calcium carbide treatment

In pineapple, an increase in yield per unit area and reduction of cost of production thereof is possible by adopting optimum planting density¹⁻³. Trials conducted at Bidhan Chandra Krishi Viswavidyalaya indicated that a plant density of 64,000/ha was optimum for North Bengal condition². A further increase in plant density reduced the percentage of flowering, fruit weight and thereby yield. Treatment with calcium carbide was found effective in augmenting the plants to flower as well as individual fruit weight⁴. The present experiment was carried out to determine the optimum plant density for maximum return by using calcium carbide.

Slips of Kew pineapple (wt. 350-400 g) were planted at a plant density of 27,777 to 1,00,000/ha (Table 1). The plants were fertilized with N, P and K at 10, 5 and 10 gm/plant per year respectively. The plants were treated with calcium carbide

(20 g/l) 390 days after planting. Fifty ml of the solution were applied at the core of the plant in the evening. The experiment was carried out in a randomized block design with six replications. Each replication accommodated 96-132 plants depending on the plant density.

An increase in plant densities from 27,777 to 1,00,000/ha reduced the percentage of flowering from 91.6 to 70.4 and the average individual fruit weight from 2.14 to 1.58 kg. The yield of fruits rose from 59.4 to 102.2 tonnes/ha by increasing the plant density from 27,777 to 72,945/ha, while a further increase in plant density was found to lower the yield by about 4.1 to 13.3 tonnes/ha. The total soluble solid and total sugar content of fruit decreased with the increase in plant density and the reduction was more pronounced by using plant densities of more than 72,945/ha. The fruit acidity was also markedly increased at the higher three plant densities tried here. Photosynthesis was more efficient in plants under low density due to the exposure of larger number of leaves to the sun. Higher per-

TABLE 1 : Fruit weight, yield and quality of fruits in pineapple under different plant densities

Plant density density (per ha)	Percentage of flowering	Fruit weight (kg)	Yield/ha (tonnes)	Total soluble Solid (°Brix)	Total sugar (% fresh weight)	Acidity ("o)
27,777	91.6	2.14	59.4	13.6	12.4	0.64
35,714	90.8	2.10	71.6	13.4	11.8	0.64
49,378	90.8	2.00	75.6	12.8	11.8	0.68
59,259	90.4	1.97	85.2	12.8	11.8	0.72
72,945	81.3	1.92	102.2	12.6	11.2	0.72
76,923	76.8	1.88	98.1	12.6	9.2	0.78
86,956	72.6	1.62	92.8	10.8	8.8	0.78
1,00,000	70.4	1.58	88.9	10.2	8.8	0.81
S. E. \pm	2.93	0.08	3.94	0.99	0.126	0.03
C. D. at 5%	8.79	0.23	11.82	N. S.	N. S.	0.09

N. S. = Not significant.

centage of flowering, increased fruit weight and better fruit quality were mainly due to the greater metabolic activity in the plants. Gunjate and Limaye³ recorded low flowering with closer planting, while calcium carbide treatment caused more number of plants to flower⁴. A decrease in fruit quality at higher planting density was reported by Roy *et al.*⁵

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Decay control of oranges by fruit coatings

Fruit decay of oranges is one of the most serious post-harvest diseases in India. The losses of fruits could be a direct consequence of mechanical damage caused during picking, handling, storage and transportation. Oranges are easily susceptible to decay-causing micro-organisms which render the fruits unwholesome for human consumption. On an average, losses of 30-35% have been observed in storage. In view of serious loss caused by some pathogens, attempts have been made to control the decay by the application of fruit coatings.

During the survey of local markets in Warangal, Orange (*Citrus reticulata* Blanco) fruits were found to be attacked by the fungi such as *Aspergillus niger* Van Tiegh, *Alternaria citri* Pierce, *Colletotrichum gloeosporioides* Penz, *Fusarium oxysporum* Schl, *Penicillium expansum* Link and *Rhizoctonia solani* Kuhn.

Post-harvest fruit decay is known to be controlled by chemical treatment¹, fungicides² in oil and wax-emulsion treatment³, and by temperature treatment⁴. The present investigation deals with the control of decay, by the application of Decco Commercial Waxes as food-grade fruit coatings during post-harvest period for prolonging the storage life of orange fruits.

Four food-grade fruit coatings were obtained from Decco Division, Pennwalt Corporation, Monrovia, California, USA. These are Decco-Lustr-DL-202, Fruit and Vegetable Kleen-FVK-241, DL-251, and DL-261 applied on fruits. The ingredients in these coatings have been approved by Environmental Protection Agency (E.P.A.) USA.

Oranges free from blemishes were washed and selected for near uniformity in size. They were allowed 5 days of ripening period at room temperature (25°-35°C) prior to surface sterilization (2 min dip in 0.1% sodium hypochlorite solution at pH 6.5 followed by two washings in sterilized water) and subsequent inoculation or treatment. The fruits were inoculated with spore suspensions of 500 spores/ml of different fungi by pin-prick method. The skin of the fruit was scratched with a needle to cause a 1 cm long injury on each fruit. The fruits were separately dipped in spore suspensions of each pathogen for 3 min. To prepare spore suspensions of different fungi, 19 day-old cultures grown on PDA medium of each pathogen were used. The fruits were incubated at 100% RH for 5 hr before they were dipped in the solutions of fruit coatings for 5 min. A separate lot of

fruits without coating was maintained as control.

Those fruit coatings miscible with water were diluted to three different concentrations to enable their application at the rate of 0.01, 0.02 and 0.04 ml/100 g fruits. Both treated and untreated fruits were stored room temperature (25-35°C) up to 20 days and were observed for fungal decay.

to the extent of 52-62%, DL-202 and DL-261 could control the green and blue-mold rots caused by *P. expansum* to the extent of 69-84%. These coatings were also able to control the rot caused by *R. solani* to the extent of 56-78%.

The authors thank Prof. L. L. Narayana, Head of the Department of Botany, Kakatiya University for facilities and also Dr. Hesh

TABLE 1 : Percentage control of post-harvest fungal decay of orange fruits treated with four different fruit coatings at three different concentrations applied at the rate of 0.01, 0.02 and 0.04 ml/100 g fruits

Name of fungus inoculated	control (without coating)	Percentage of fruits affected											
		DL-202			FVK-241			DL-250			DL 261		
		0.01	0.02	0.04	0.01	0.02	0.04	0.01	0.02	0.04	0.01	0.02	0.04
<i>A. niger</i>	27	20	13	5	23	14	8	21	15	9	19	13	9
<i>A. citri</i>	25	22	17	5	19	15	9	22	16	5	18	12	7
<i>C. gloeosporinoides</i>	24	19	14	8	15	10	5	20	13	7	18	14	9
<i>F. oxysporum</i>	21	20	16	9	17	13	10	18	11	8	16	12	9
<i>P. expansum</i>	26	23	13	5	21	15	7	22	16	8	14	9	4
<i>R. solani</i>	23	20	15	7	19	14	10	21	16	8	20	12	5

The inoculated orange fruits that were coated did not show any decay in storage up to 20 days. Then the decay started slowly. In control fruits without coating, the decay appeared within 10 days. After 20 days of storage, the control uncoated fruits were damaged completely. All the four fruit coatings applied on orange fruits effectively controlled the fungal decay at higher concentrations of 0.02 and 0.04 (Table 1). At 0.01 concentration, they were less effective. At 0.02 and 0.04 concentrations, DL-202 formulation was more efficient as it controlled the black rot caused by *A. niger* and *A. citri* to the extent of 67-81 and 64-80% respectively. The coating FVK-241 and DL-250 were more efficient in controlling the anthracnose caused by *C. gloeosporioides* to the extent of 62-79%. The formulation DL-250 controlled white spots caused by *F. oxysporum*

J. Kaplan, Director, Decco Division, Pennwalt Corporation, Monrovia, California, USA for the supply of samples of food-grade fruit coatings.

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Planting density trial on ginger (*Zingiber officinale* Roscoe) on dry terraces of mid-altitude Mizoram

Ginger is the most important cash crop of Mizoram but is cultivated mostly on hill slopes without any standard spacing. Very little cultivation is done on dry (rainfed) terraces. No research work has so far been done on this crop under Mizoram agro-climatic conditions. This experiment was, therefore, conducted to find out the most optimum planting density for ginger under rainfed terrace conditions of Mizoram.

The soil of the experimental plots at the ICAR Mizoram Centre at Kolasib (800 m above MSL) was sandy loam with high organic carbon (2.08%), very low available P_2O_5 (0.56 kg/ha), almost low available K_2O (190.4 kg/ha) and 5.35 pH. The 3-repli-

cation randomised block design trial had net plots of 2 m × 1 m each and contained 5 spacing treatments accommodating 1,00,000 to 2,00,000 plants/ha. Finger rhizomes (average 15 g) of a local cultivar, 'Thinglaidum', were sown on 12th May, 1980. All plots had received uniform applications of N 100 + P 60 + 60 kg/ha. No irrigation was given nor any pesticides used. The crop was harvested on 19th January, 1981.

Second-closest planting density (25 cm × 25 cm) had produced significantly taller plants (Table 1) than other densities except the closest one (20 cm × 25 cm). Similar planting density effect in plant height was also reported in turmeric^{1,2}. Production of neither tillers nor leaves (Table 1) was affected significantly.

A significant highest yield (fresh rhizome)

TABLE 1 : Height of plant, tillers/plant, leaves/plant and fresh rhizome yield of ginger cv. "Thinglaidum" grown on rain-fed terraces in Mizoram (800 m above MSL) under 5 planting densities

Planting density (plants/ha) with corresponding spacing (cm)		Plant height (cm)	Tillers/plant (no)	Leaves/plant (no)	Yield/plot of 2 m ^a (kg)	Yield/plant (g)	Commuted yield/ha based on per-plot yield (kg)
2,00,000 (S ₁) (25 × 20)	...	27.3	3.8	9.5	1.100	27.1	5500
1,60,000 (S ₂) (25 × 25)	...	29.9	4.3	10.0	1.560	41.5	7800
1,33,333 (S ₃) (25 × 30)	...	25.1	3.7	10.2	0.677	26.4	3390
1,14,286 (S ₄) (25 × 35)	...	24.4	3.8	9.4	0.590	26.4	2950
1,00,000 (S ₅) (25 × 40)	...	25.5	3.0	9.3	0.450	26.3	2250
Mean		26.45	3.7	9.69	0.875	29.5	4380
SE _m ±		1.12	0.32	0.47	0.204	5.39	1020
C.D. (0.05)		3.65	NS	NS	0.662	NS	3310

^a Healthy and functioning, not total, leaves/plant.

was obtained under second-closest spacing which was, however, at par with the closest spacing (Table 1). That, in this study, the closest planting had yielded less than the second-closest planting. It shows that there is a limit to close planting as observed by other workers^{3,4}. Yield response, in this study, conforms to other planting density trials on ginger^{5,6} and on turmeric^{2,7}. Although planting density effect on per-plant yield (Table 1) was not significant, this yield was also highest under second-closest spacing. From results of this trial it may be concluded that a spacing of 25 cm × 25 cm (1,60,000 plants/ha) is the most optimum for planting ginger on dry terraces of mid-altitude Mizoram.

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Effects of Minerals on the Production of Bakers' Yeast by *Saccharomyces cerevisiae*

Microorganism require specific minerals for growth and metabolic activities. This requirement varies with the type of organism

as well as the nature of basal medium used. Considerable studies have been made on the requirement of minerals for growth of Bakers' yeast, Shkidchenko¹ reported that when phosphate was restricted, the phosphorus pool decreased before growth rate decreased and was accompanied by changes in respiration and metabolite production. The threshold phosphorus concentration for yeast growth was 0.7 ppm. Jacobsen and Sturla² reported Zn as an important element for yeast cells. At 0.2 ppm, Zn promotes and produces optimal growth of yeast. The addition of complex preparation containing Mn, B, Zn, Cu, Co, Mo and I to molasses medium increased the Bakers' yeast production³. It was also reported that in molasses medium supplemented with 'carboxylin' (a mixture of NaHCO₃, MgSO₄, MnSO₄ and ZnSO₄) the biomass of Bakers' yeast increased^{4,5}. Muciniece *et al.*⁶ reported that MnSO₄ 0.1 and (or) FeSO₄ 0.024 g/L were detrimental to yeast growth and NaCl at 0.22 g/L limited both the growth rate and the total yield of yeast cells.

The present study was undertaken to examine the mineral requirements of *Saccharomyces cerevisiae* B₁ for Bakers' yeast production in a synthetic medium.

In the course of mutation studies with ethyl methane sulfonate and UV irradiation of *Saccharomyces cerevisiae* strain, a mutant *S. cerevisiae* B₁ was selected for the Bakers' yeast production. This mutant was maintained in the medium (pH 5.0) consisting of glucose⁷, 1%; (NH₄)₂SO₄, 0.5%; KH₂PO₄, 0.1%; MgSO₄·7H₂O, 0.025%; FeSO₄·7H₂O, 0.002%; biotin, 0.5 µg/ml; agar, 3%. Earlier studies by us on the carbon and nitrogen sources for Bakers' yeast production by *S. cerevisiae* B₁, showed that sucrose and ammonium sulfate were the best carbon and nitrogen sources respectively.

The effect of different minerals was studied in the medium consisting of

sucrose, 5% ; $(\text{NH}_4)_2\text{SO}_4$, 1.5% ; KH_2PO_4 , 0.5% ; $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$, 0.25% ; biotin, 1 $\mu\text{g}/\text{ml}$ at pH 4.5. All the chemicals for the medium were of analytical reagent grade and were obtained from E. Merck. Clear pyrex glassware and triple glass-distilled water were used throughout the study.

Sucrose, $(\text{NH}_4)_2\text{SO}_4$, KH_2PO_4 , $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ were freed of trace elements by the following method⁸ : The required amounts of these chemicals were dissolved separately in 200 ml of demineralized water, the resulting solution was shaken twice with a mixture of 0.1 g of 8-hydroxyquinoline and 5 ml of chloroform in a separating funnel, first at pH 7.2 and then at pH 5.2. After each extraction the solution was washed three times with 5 ml of chloroform to free the medium from traces of 8-hydroxyquinoline. After purification, all the solutions were sterilized in autoclave at 15 lbs pressure for 15 mins. Biotin solution in water was sterilized by filtration.

The basal medium initially did not contain the mineral salt to be tested. The salt was added in graded doses to the medium. In each subsequent experiment the composition of the basal medium was so altered as to include an optimal quantity of the salt determined from the previous experiment. The sterile medium (30 ml) was aseptically taken in a 100 ml flask and inoculated with 1 ml of inoculum containing 2×10^8 cells.

For the preparation of inoculum, the culture was grown in 30 ml of a synthetic medium consisting of glucose, 5% ; $(\text{NH}_4)_2\text{SO}_4$, 1.5% ; KH_2PO_4 , 0.5% ; $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$, 0.25% and biotin 0.5 $\mu\text{g}/\text{ml}$ at pH 5.0 in 100 ml flasks for 18 hours at 28°C on a rotary shaker (240 r.p.m.). After harvest the cells were washed thrice with sterile water and then resuspended in 30 ml of water.

The inoculated flasks were incubated at 28°C on a rotary shaker at 240 r.p.m. for 24 hours. At the end of fermentation,

the cells were filtered in Whatman No. 1 filter paper which were previously weighed to a constant weight and washed with distilled water for four times. The filter papers containing the cells were dried in a drier at $50^\circ\text{C} \pm 5^\circ\text{C}$ for 24 hours and then kept inside a desiccator and weighed to a constant weight. The growth was expressed as dry cell weight in mg per ml of broth.

The baking activity of the yeast was determined by testing the gas producing power of the yeast. This was carried out in a small sample of dough medium containing 100 g flour, 0.5 g dry yeast, 1.25 g NaCl and 58 ml water at 35°C by the method of Burrows and Harrison⁹ based on gas volume measurement

It was observed that the optimum concentration of KH_2PO_4 and $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ should be 0.5% and 0.25%, respectively for Bakers' yeast production both higher and lower concentration of those salts had negative effect on the cell growth. NaCl had no stimulating effect on yield, whereas $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$ in concentration more than 0.1% was detrimental to the cell growth. The effects of trace elements Mn, Mo, Co, Zn, Fe, Cu on the growth of *S. cerevisiae* B₁ are shown in Table 1. Mn, Mo and Co had no stimulatory effect on cell growth ; however, if Co was added more than 5 $\mu\text{g}/\text{ml}$ it had some adverse effect. Zn and Fe have some effect on the cell growth and should be added to the medium at a concentration of 15 $\mu\text{g}/\text{ml}$ and 10 $\mu\text{g}/\text{ml}$ respectively. On the other hand, Cu had significant effect and 5 $\mu\text{g}/\text{ml}$ was sufficient for cell growth, but more than 5 $\mu\text{g}/\text{ml}$ was detrimental.

Based on the observations, the following synthetic medium is recommended for production of Bakers' yeast by *S. cerevisiae* B₁ : Sucrose 5%, $(\text{NH}_4)_2\text{SO}_4$ 1.5%, KH_2PO_4 , 0.5%, $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ 0.25%, $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$ 15 $\mu\text{g}/\text{ml}$, $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ 10 $\mu\text{g}/\text{ml}$, $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ 5 $\mu\text{g}/\text{ml}$, biotin 1 $\mu\text{g}/\text{ml}$ at pH 4.5. In this medium the yield of dry Bakers' yeast is 6 mg/ml of broth.

TABLE 1 : Effect of trace elements on the growth of *Saccharomyces cerevisiae* B₁ for production of Bakers' Yeast

Trace element	Concentration (µg/ml)	Dry cell weight (mg/ml)
Mn [MnSO ₄ .4H ₂ O]	0	5.0
	1.0	5.0
	5.0	5.0
	10.0	5.0
	15.0	5.0
	20.0	5.0
Mo [(NH ₄) ₆ Mo ₇ O ₂₄ .4H ₂ O]	0	5.0
	1.0	5.0
	5.0	5.0
	10.0	5.0
	15.0	5.0
	20.0	5.0
Co[CoSO ₄ .7H ₂ O]	0	5.0
	1.0	5.0
	5.0	5.0
	10.0	4.9
	15.0	4.8
	20.0	4.8
Zn [ZnSO ₄ .7H ₂ O]	0	5.0
	1.0	5.0
	5.0	5.0
	10.0	5.2
	15.0	5.5
	20.0	4.8
Fe [FeSO ₄ .7H ₂ O]	0	5.5
	1.0	5.5
	5.0	5.5
	10.0	5.7
	15.0	5.3
	20.0	5.1
Cu [CuSO ₄ .5H ₂ O]	0	5.7
	1.0	5.7
	5.0	6.0
	10.0	5.4
	15.0	5.0
	20.0	4.5
Control		5.0

The gassing activity of Bakers' yeast produced in this medium by *S. cerevisiae* B₁ has been found to be 208 cc (CO₂) at 35°C for 130 mins of incubation of the dough medium.

We thank Dr. S. K. Majumdar, Professor, Department of Food Technology and Biochemical Engineering, Jadavpur University and Professor, S. K. Bose, Department of Biochemistry, Calcutta University for their kind advice and interest in this work.

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Received : 28 October, 1986.

Revised : 6 February, 1987.

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Root-knot nematode *Meloidogyne arenaria* (Neal) Chitwood—a new pest of jute in North Bengal

During 1985 Kharif season a team of experts from Jute Agricultural Research

Institute went to North Bengal to determine the cause of unthrifty growth of jute in that region. A host of factors such as stunting, yellowing and wilt of plants were recorded. Plant and soil samples were brought to JARI for analysis.

A part of the soil sample was screened. Several nematodes including plant parasitic forms like *Hoplolaimus indicus*, *Helicotylenchus* sp. and larvae of *Meloidogyne* sp. were found to be present in it.

Jute plant roots collected from Dinhata block were heavily galled. Root-knot nematode adult females were recovered from those galls. Perineal pattern of those were examined. The patterns were oval to rounded in shape with low arch and short distorted striae on lateral lines. The species was identified to be *Meloidogyne arenaria* (Neal) Chitwood.

Many workers have recorded different nematodes on jute¹⁻⁴. Among those three species of root-knot nematodes had been mentioned⁵. But infection by the species identified at present is recorded for the first time.

The nematode was cultured on jute plants, cultivar JRO-632 at temperature range of 24° to 31°C. Freshly hatched larvae were inoculated to plants grown in 1:1 soil:sand mixture in 10 x 2.5 cm openend glass tubes. Daily one tube was removed and washed free of soil and examined under stereoscopic microscope to note nematode development. Observations have been recorded in Table 1.

Twenty four hours after inoculation most of the larvae were found to be in various stages of penetration into root tips and some at the zone of elongation. After 48 hours many larvae were completely within the roots. Root tissue at the head region of the larvae stained deeper than surrounding cells, indicating the initiation of giant cell formation. The root tips penetrated by many larvae assumed club shape. Such root tips did not grow further as found from later observations, thus restricting the growth of nematodes also.

TABLE 1 : Development of *Meloidogyne arenaria* on jute cultivar JRO 632 at 24° to 31°C

Days after inoculation	Nematode		Development stage	Host reaction
	Activity	Shape		
1 day	Penetrating	Slender vermiform	2nd stage larvae	—
2 days	Penetrating and feeding	Slender	2nd stage	Cells at feeding zone having dense cytoplasm.
3 days	feeding immobile	Slight swelling	2nd stage	Giant cell formation (Hypertrophy).
4 to 10 days	Feeding	Saccate with tail	3rd stage	Hypertrophy complete, Hyperplasia progressing.
10 to 14 days	Feeding and molting	Oval and Saccate	Developing females ; Developing males	Galls completely formed. Galls formation inhibited.
14th day and beyond	Males emerging	Vermiform	Adult males	Culicle wounded.
16 days	Molting complete	Spherical	Adult female	Root epidermis broken.
18 days	Egg sac produced	Spherical	Adult female	Root epidermis broken
20 to 28 days	Reproduction @ 20 eggs per day	Spherical	Adult female	Root epidermis broken.
28 days	Egg development	Vermiform	Reached 2nd stage	2nd generation emerge.
29 days	Egg laying continues ; Hatching occurs	Vermiform	Reached 2nd stage	Reinfestation occurs.
40 days	♀ Feeding stopped	Round	2nd generation	Galls formed on feeder roots.

Root swellings were visible somewhat away from the tip of the root 96 hours after inoculation. Nematode larvae recovered from such roots were a bit swollen and unable to move. Only a few of them could just turn their head. Four to 10 days after inoculation galls were visible on small to large roots. On 10th day galls on smaller roots were almost spheroid in shape. Dissection of such galls revealed the presence of large giant cells near the head of nematode larvae which blocked the vascular tissue. In simple galls on small roots two to three giant cells were present each measuring 0.5 to 1 mm. Around giant cells root cortex was swollen due to hyperplasia. Nematode larvae were swollen, saccate, opaque and with thick cuticle, but retained the small pointed tail. This indicated that the larvae were in 3rd stage. On 14th day a few larvae were seen developing into males. They were observed mainly at sites where many larvae penetrated together. On 16th day larvae in round galls were seen with almost rounded body, and developed ovaries indicating maturation to female. Some males were found to emerge out of molt skin.

On 18th day females were seen pushing their egg sacs behind them to the root surface. Males were also found emerging out of galls and club-roots. The specimens recovered from galls on large roots or plant base were seen lagging behind in development. From 20th day egg production was recorded in some females. On 28th day many egg masses were found with more than 100 eggs. Many of the eggs were fully developed and hatched into 2nd stage larvae when teased. Thus it may be concluded that life cycle was completed by 28 days at the earliest. During this period galls on large roots and plant base revealed that nematode development was slower there. Many larvae were yet in 4th stage and females inside them laid fewer number of eggs. This indicated that pressure exerted by hard root tissue on nematode larvae

retarded their development and fecundity.

On 40th day many females were found to have produced 200 to 350 eggs inside their egg masses. Most of the eggs were fully developed but hatching was limited as evidenced from presence of very few empty egg shells inside the egg sac.

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Received : 16 April, 1986.

Revised : 5 February, 1987.

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Total lipid, cholesterol and fatty acids in *Ceylonocotyle scoliocoelium* —a quantitative survey

Quantitative estimation of total lipids in trematodes in relation to dry and fresh weight are available^{1,2}. Smith *et al.*³ investigated cholesterol and fatty acid synthesizing ability of trematode parasites. Hrzenjak *et al.*⁴ studied fatty acids of *Fasciola hepatica*. In helminths cholesterol is the most important sterol but of dietary origin⁵. Distribution of different lipoidal materials in parasites has been studied by histochemical methods. For obvious reasons quantification of lipids in different organs of flatworms can not be studied⁶. Present communication embodies a quantitative study of total lipid, cholesterol and fatty acids in the Amphistome trematode *Ceylonocotyle scoliocoelium* inhabiting rumen of *Capra capra*.

The trematodes collected from rumen of autopsied goats were washed in 0.67%

TABLE 1 : Percentage of total lipid, cholesterol and fatty acids in the Amphistome Trematode *Ceylonocotyle scoliocoelium* (Mean values in terms of mg fresh weight \pm SEM of 15 observations)

Total lipid in the tissue	Total cholesterol in the tissue	Cholesterol value expressed in terms of lipid	Total fatty acids in the tissue	Fatty acid value expressed in term of lipid
4.89 \pm 0.106	1.26 \pm 0.175	25.7	0.8 \pm 0.01	16.3

saline, soaked on filter paper, weighed and weights recorded. Total lipid from the tissue was extracted in a mixture of chloroform and methanol following a modified method of Entenman⁷ and estimated the same colorimetrically using vanillin reagent as colour developer⁸. Fatty acids was extracted from the trematodes after Entenman⁷ and estimated the same colorimetrically after Barnes *et al.*⁹ using vanillin reagent as colour developer. Cholesterol was extracted and estimated after Roy *et al.*⁹ using ferric chloride as the colour reagent.

The value 4.89% total lipid content of *C. scoliocoelium* falls well within the range of 4.23 to 9.65% (in terms of fresh weight) as determined by Yusufi and Siddiqui¹⁰ in six different trematodes. From the available literature^{11,10} and present findings no generalisation can be made as to the lipid content of trematodes and their habitat conditions, especially oxygen content of the area. Yusufi and Siddiqui¹⁰ studied fatty acids and cholesterol of five trematodes inhabiting different organs of their hosts and determined values ranging from 5.0 to 16.5% and 4.1 to 14% respectively. It has been observed that rumen inhabiting trematodes¹⁰ present identical fatty acid quantifications as also in *C. scoliocoelium*. The cholesterol content of *C. scoliocoelium* is at a comparatively higher level than that of *F. buski*¹⁰ which 14 mg %. Informations regarding utilisation of host lipid by trematode and nematode parasites are available where ability of the endoparasites to disturb host's nutrition and storage biology have been discussed¹¹⁻¹³. It is likely that the total lipid and lipid fractions of the trematode

under investigation are of dietary origin absorbed by the parasite from its host's rumen.

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Received : 29 September, 1986.

Revised : 12 February, 1987.

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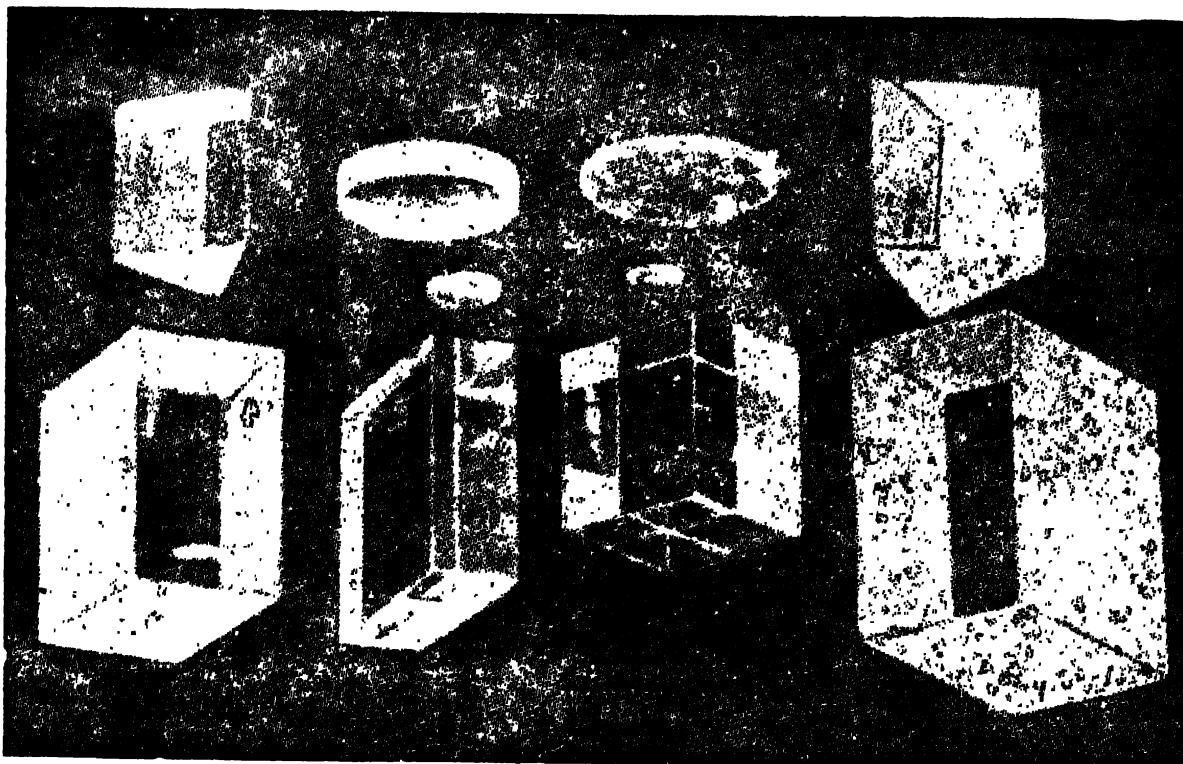
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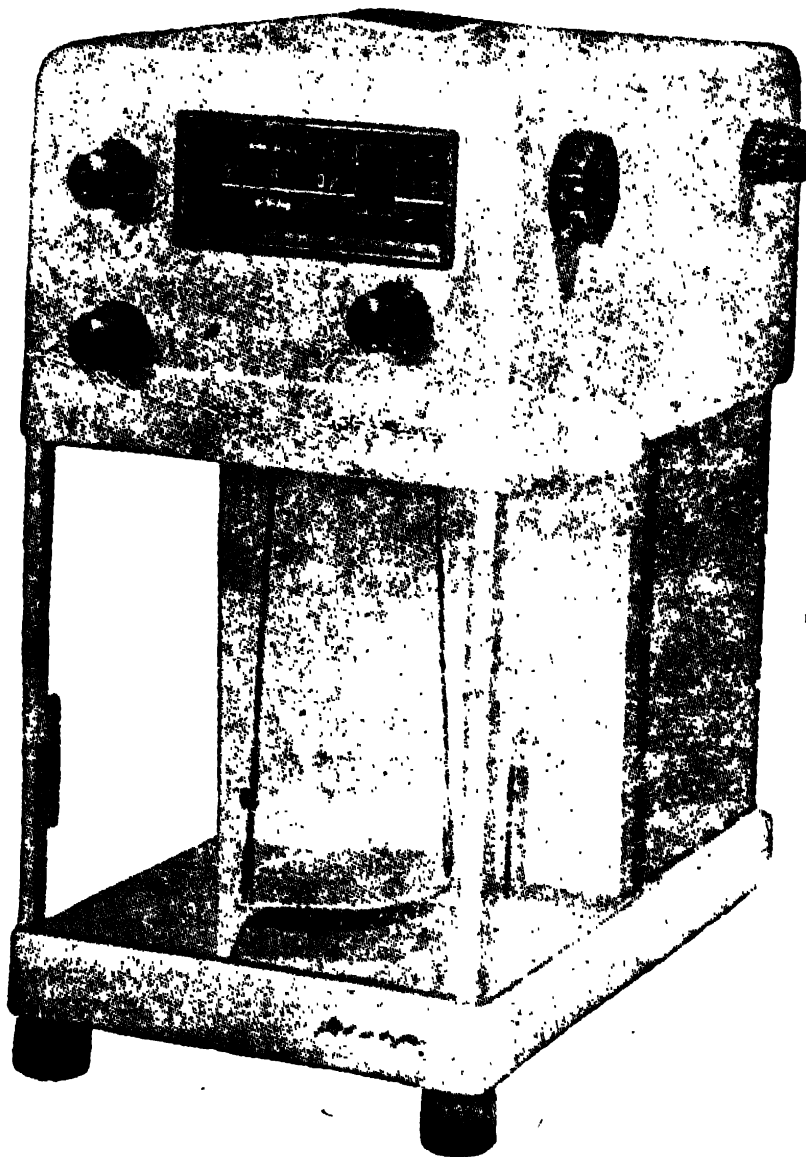
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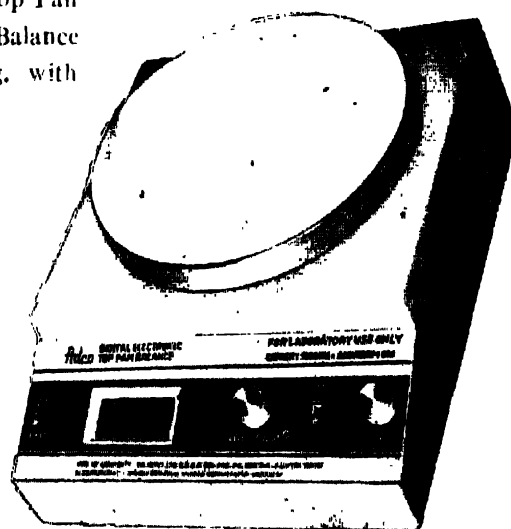
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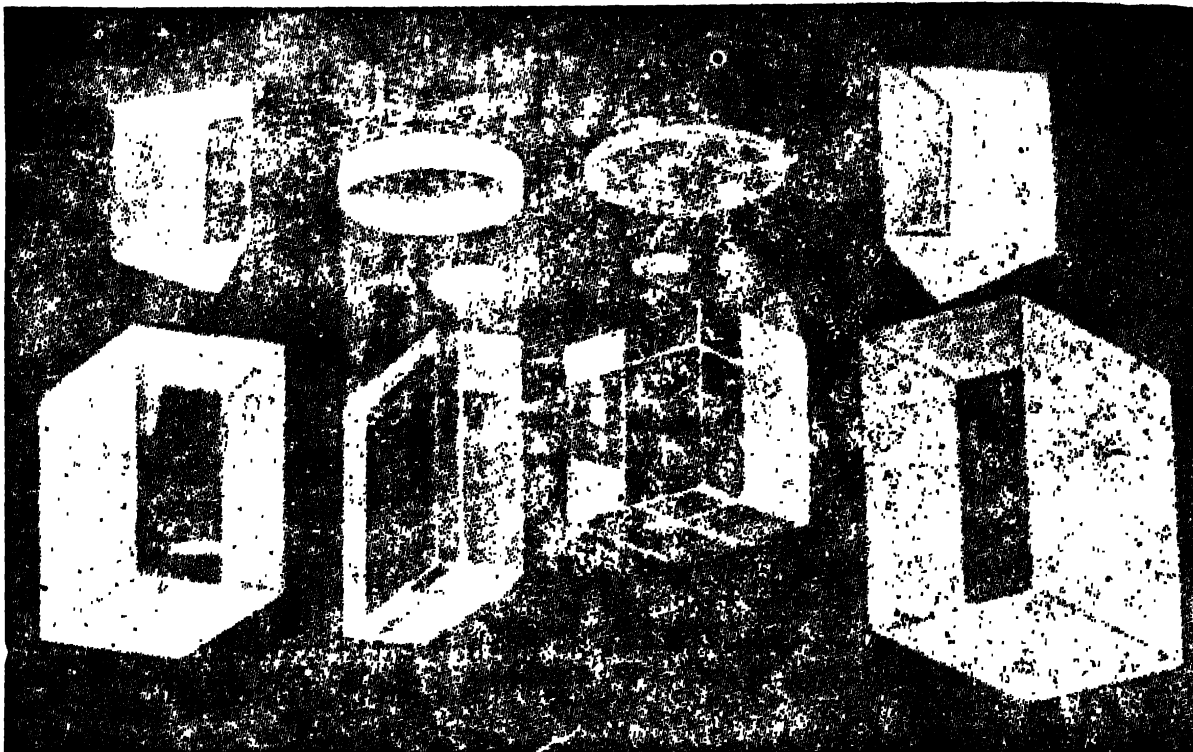
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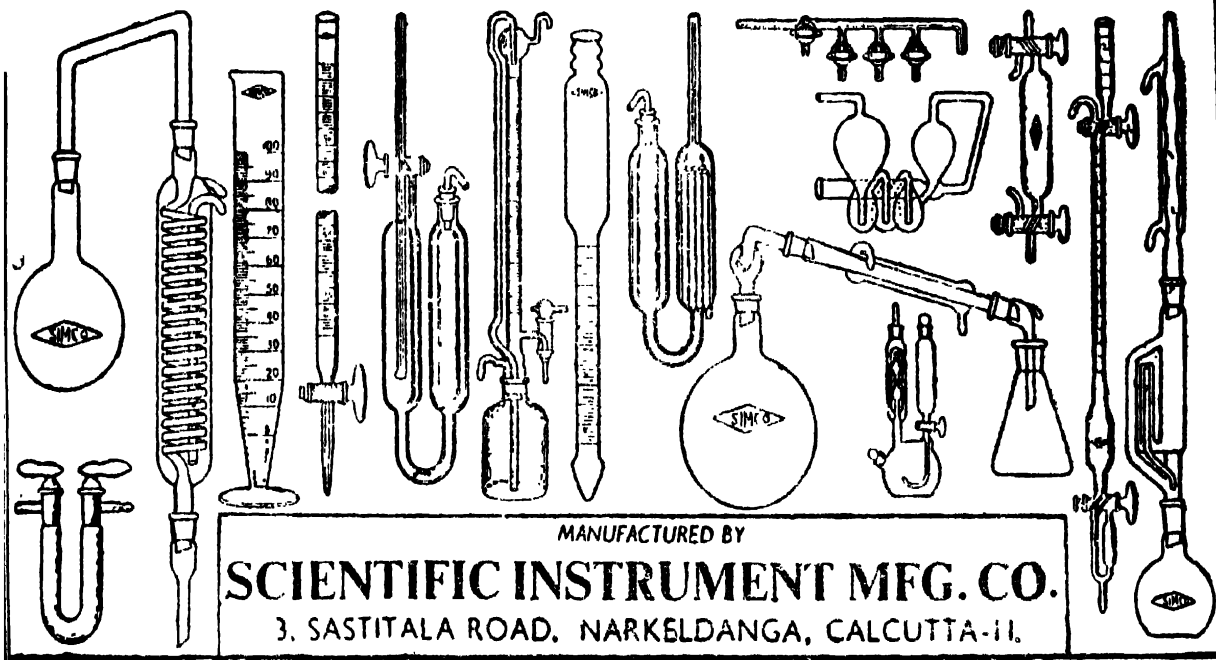
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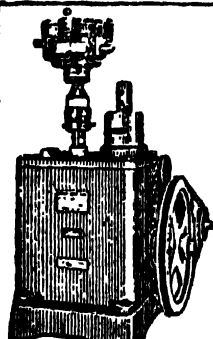

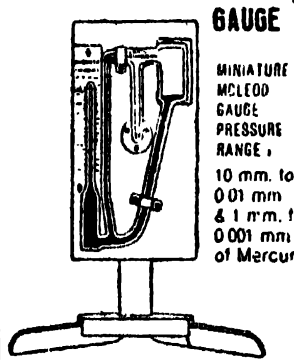
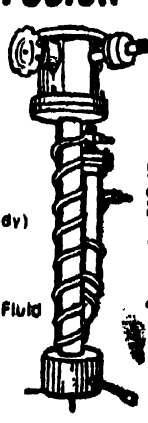
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May 1987/Volume 53/Number 5

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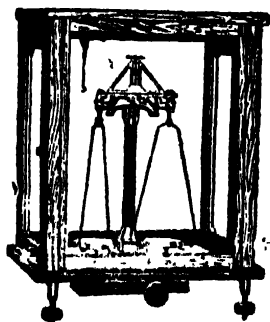
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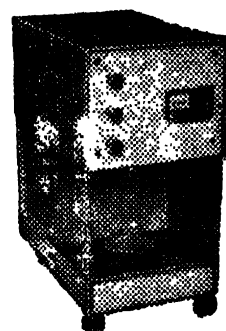
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CRUCIAL IMPORTANCE OF OIL-SEEDS AND EDIBLE OILS

THE Indian Science News Association highlighted the crucial importance of oil-seeds and edible oils particularly in respect of regional imbalances in the Eastern Region compared to other regions in the country in the last week of November, 1986. This was felt a necessity not only because out of the 8th Thrust Missions one Thrust Mission has been particularly charged to the task of finding out solution of the chronic shortage of the commodity which is so vital for health and well-being as also for the industry.

The position of the Eastern Region is even more critical for the reason that while the total number of consumers as a zone is much higher than that of the other zones, the total availability of oil bearing raw materials is the minimum in this zone. For example, in West Bengal about 90% of the requirements of the oil-seeds is imported from other States like U.P., Rajasthan, Andhra Pradesh, Gujrat etc. to keep our oil mills running. It was felt while the Thrust Mission obviously would try to do its job. It might be helpful to the work of the Thrust Mission as also the Department of Civil Supplies both in the Centre and in the States if a formulated view is obtained from the collected representatives of various interests—agriculture, commerce, research organisations and Universities both producers and users and traders and manufacturers are brought to

bear their indepth knowledge with the background of the felt necessities of each discrete units of the zone before them.

As will be found elsewhere in the last issue that while the production of oilseeds has increased on the average at the rate of 2% annually during the last 30 years the rate of increase of population has been about 2.5% on an average making the shortage more acute. Again, there has been a fluctuation of 25% from year to year. A few examples will be sufficient to bring home this point. For example, in the case of groundnut oil between 1950-51 and 1982-83 the production has varied between 8 lakh tonnes rising to about 16 lakh tonnes in 1975-76 and going down to 11 lakh tonnes in 1980-81 and again in 1982-83 coming back to the level of about 9.5 lakh tonnes Coconut Oil—another important oil, the production of which was 1 lakh ton in 1950-51 has only come to the level of 1.8 lakh ton in 32 years. The total oil supply has only doubled between 1950-51 from the level of 14.2 lakh tonnes to 28.2 lakh tonnes in 1982-83. We have minimum requirement of about 45 lakh tonnes and it has been estimated that we may have a gap between supply and demand between 40-70 lakh tonnes depending on our growth rate in National Income.

In the current crop season against a forecast of production about 50 lakh tonnes

we have been able to produce about 34 lakh tonnes only. The result has been ofcourse dependency on imports from mainly 3 countries viz. U.S.A. for Soybean Oil, Canada for Canola or Low Erucic Rapeseed Oil and Malaysia for Palm Oil and Palm Olein.

The Seminar tried to discuss this crucial problem both from a national angle and a

regional angle. The organisers will feel amply rewarded if the deliberations of the Seminar has been able to bring home to the readers the urgency for solution of this crucial problem and to the planners at the national level some possible ways of solution of this national problem which is also connected with our survival. □

M. M. C.

REPORT OF THE SEMINAR ON REGIONAL IMBALANCE IN AGRICULTURE WITH SPECIAL EMPHASIS ON OILSEEDS

The seminar on "Regional Imbalance in Agriculture with Special Emphasis on Oilseeds", organised by the Indian Science News Association, Calcutta-9 was held on November 25, 1986 at the Saha Institute of Nuclear Physics, Calcutta-9 within the campus of the Calcutta University College of Science and Technology. The seminar was well attended by groups of scientists, scholars and eminent industrialists. The meeting had two sessions- morning and afternoon, dealing with topics pertaining to Agriculture of oilseeds and oil technology respectively.

The Secretary of the Indian Science News Association, Prof. A. N. Daw welcomed the participants and guests present in the meeting. Shri R. N. Mody, Chairman of the Board of Directors of M/S. Rasoi Vanaspati and Industries Ltd. delivered the keynote address in which he dealt with the various aspects of oilseed production in the eastern region and its relation to the development of vegetable oil production for food and industry. He emphasized on the revision of the present method of approach for increasing the oilseed production in the planning policy of the Central Government. Prof. P. N. Nandi, the convener, explained in his

introductory speech the importance of this seminar and proposed that specialists participating in the seminar will formulate principles for approach to the problem of regional imbalance in oilseed production and recommend ways to make up shortfall of this important commodity. The inaugural address was delivered by Dr. M. V. Rao, Secretary of Indian Council of Agricultural Research, New Delhi who discussed various facets of oilseed production including genetics, agronomy and allied methods to be adapted for the improvement of production of oilseeds so that we could reach the target of surplus production. This would reduce the necessity of importing oil for edible purposes in India. Dr. Rao also explained the economics of oilseed production in India.

The Guest in Chief Prof. B. D. Nagchauri former Vice-Chancellor of Jawaharlal Nehru University, New Delhi delivered an address in which he explained that proper methodical approach to boost oilseed production should be done and necessary planning will strengthen our position in the agricultural sector in India. He thought that we would reach the goal of self sufficiency in our requirement of vegetable oils in India.

In the morning scientific session on Agriculture of Oilseeds Prof. B. N. Chatterjee of the Bidhan Chandra Krishi Viswa Vidyalaya, Kalyani presided and he spoke on the agronomical aspects of oilseed production in the eastern part of India. He explained in his lecture with the help of figures the quantitative aspects of oilseed production. He thought that the deficiency in production of oilseeds could be made up by careful and methodical approach to the problem. Prof. Chatterjee's speech was followed by a talk on the Diseases of Oilseed Brassicas by Prof. K. R. Samadar of Kalyani University. He reported the prevalence of diseases amongst the Brassicas and recommended modern methods of crop protection and improved production. He specially referred to the adoption of tissue culture methods to produce resistant strains of Brassicas so that the loss due to plant diseases will remain at a lower level.

The afternoon session of Oil Technology was presided by Prof. M. M. Chakrabarti former Vice-Chancellor of the Jadavpur University. The first speaker was Dr. R. S. Vaidyanathan of M/s. Rasoi Vanaspati and Industries Ltd. The speaker discussed the

aspects of production of oil from oilseeds and explained how the modern technological methods of oil production could be used as tool for increased production in future planning. He also spoke on the chemistry of hydrogenation of fats and oils. Dr. Dipak Bhattacharya of the Deptt. of Chemical Technology, Calcutta University discussed the mode of approach to arrive at the goal of self-sufficiency in oil and fat production in India. He stressed on the different steps to boost oilseed crop production, adoption of new technology for processing oilseeds and chemical refining of oils and fats. His address covered most of the aspects of oilseed and oil production and related economics.

At the conclusion Prof. M. M. Chakrabarti gave a summary of vegetable production and the lacunae therein. Prof. P. K. Bose, the President of the Indian Science News Association, in his address, thanked everyone participating in the seminar and expressed his hope that the recommendations laid down by the speakers will become useful for future planning of agricultural development in India with respect to improve oilseed production. □

SELF-SUFFICIENCY IN OILS AND FATS IN INDIA THROUGH AGRICULTURE, PROCESS AND PRODUCT-MIX DEVELOPMENTS*

D. K. BHATTACHARYYA**

INDIA has been passing through the phase of acute shortage of vegetable oils and fats for over the past two decades and in order to meet the demand requirements the country has been forced to import huge quantity of oils incurring foreign exchange to the tune of 1200-1500 crores of rupees. Such a situation can not continue and should not be allowed to continue and

considering the balance of payment it is high time that efforts are made on war

*Presented at the Seminar on Regional Imbalance in Agriculture with Special Emphasis on oilseeds held on November 25, 1986 under the auspices of Indian Science News Association.

**Department of Chemical Technology, University Colleges of Science & Technology, 92, A. P. C. Road, Calcutta-700009

footing to stop completely the import of oils and fats.

Three basic can be considered as measures by means of which the availability of oils and fats can be increased in India to meet the demand in full. The first and the foremost step is to launch massive agricultural and post harvest technology programmes. The production target of oilseeds during the 7th Plan period must be met at any cost. In order to achieve the target, measures for immediate implementation are (i) to consolidate the production of the major oilseed crops in the existing growing states by providing all the necessary agricultural inputs (ii) to tap all the minor oilseeds and by product sources vigorously for which necessary collection and post-harvest technology steps such as 'drying and storing' have to be adopted (iii) each state be asked to grow oilseed crops in Kharif and Rabi seasons on fallow lands (iv) to go for palm and coconut plantation on a bigger scale in Kerala, Andaman & Nicobar and other coastal areas as these two sources can provide unique vegetable oils for edible, soap and oleochemical industries and (v) to assess viability as regular oil-seed crops of the large variety of oilseeds of different plant families which have been identified in different parts of the country

The next important step is to adopt new technologies for processing oilseeds and their constituents for much better edible and industrial utilisations. Some of the process technologies that need special attention include (i) New extraction process for oilseeds so that the quality of oils as also the non-oil constituents are much better than those that could be obtained by the existing methods of extraction. One such process involves extraction of oils by super critical carbon dioxide or by other supercritical fluids. It is a very promising technology as the extracted oils are invariably low in gum and colour and consequently refining of oils is much easier. Also it is possible

to achieve simultaneously the partial deacidification of oils, dewaxing, and even fractionation into stearins and oleins by manipulating temperature and pressure in recovering carbon dioxide. Direct extraction without prepressing for high oil-bearing seeds should also receive attention. Agro-based solvent like ethanol should be explored for extraction in view of increasing cost of hexane. Extraction by water to recover oil and protein at the same time should receive also attention.

(ii) New *refining technologies* like physical refining using steam under high vacuum, wipe film evaporation under high vacuum, miscella refining with a single or double solvent should be adopted more regularly for the minor oils of our country having high f.f.a., dark colour and odour problems. The deacidification of high f.f.a. oils by liquid-liquid extraction and alkali neutralisation, and by combination of reesterification and alkali neutralisation are also potential refining processes for our country.

(iii) Modification technology like the inter-esterification process should be adopted to produce vanaspati and margarine fat bases in place of the classical hydrogenation process which is energy intensive and costlier.

Modification of oils and fats to produce special edible fats and industrially useful fats by fractionation should be encouraged. Lipofroc process, involving the use of surface active compounds for segregating a fat or an oil into stearin and olein fractions can help in making frying oils, bakery shortenings, toilet soaps, coating materials and oleochemicals.

(iv) *Biotechnology* involving the action of microbial lipases has been gaining importance throughout the world in modifying oils and fats to more value added products for food and industrial applications. Tremendous scopes also exist in India for making vanaspati, confectionery and margarine fats by highly selective microbial lipases on

vegetable oils and fats of indigenous origin. Single cell fat production by growing certain microorganisms on carbon source like glucose that can be obtained from oilseed carbohydrates should also receive attention.

While massive agricultural programmes and new process technologies are the primary steps to increase the availability of oils and fats in India, it is also highly imperative that new product mix are produced in our country as indicated below to cover edible and industrial requirements :

- (i) The production of margarine and low cost spread fats for better nutritional and cost benefits of the vast majority of population.
- (ii) Bakery shortenings using interesterification and blending process.
- (iii) Release agents and emulsifiers for bakery industries and also in frying media to improve economy of consumption of oils and fats.

(iv) Blended oils and flavoured oils to provide inexpensive and high quality oils.

(v) Protein fortified bakery products, meat analogs and milk extenders from the oilseed proteins in the form of protein concentrates and or protein isolates.

(vi) Oleochemicals like fatty alcohols, fatty amines, methyl esters of fatty acids, dibasic and dimeric acids etc. to meet the needs of chemical industries like detergent, polymer, textile and so on, which in turn will cater to the consumer at large.

Attempt has been made to indicate some measures on agriculture, process technologies and product mix which can be adopted in our country and these on implementation will certainly help India to become self-sufficient in oils and fats to cater to the country's edible and industrial needs. □

REGIONAL IMBALANCE IN AGRICULTURE WITH SPECIAL REFERENCE TO OILSEEDS*

R. S. VAIDYANATHAN**

OILSEEDS and edible oil are very much in the news since the last one year and there are concerted efforts at various levels to plug the drain of foreign exchange spent for importing edible oils.

While the ultimate solution will be to boost up agricultural production and solve the problem, this is going to be time consuming in spite of the best efforts for the simple reason the oilseed crops are dependent on rain-fed conditions apart from other market forces like support prices, regional preferences, availability of high yielding variety of seeds etc. This is a long-term measure.

As a short-term measure, wherein tangible achievements can be seen early will be

through modernization of equipments, insisting on energy efficient process and an open mind of the Government on end products like product mix and new processes will go a long way in finding an early solution to the matter.

Let us see the facts. It is established beyond doubt over the years that the deficit between supply and demand of edible oils is of the order of 15 lakh tonnes. This tends to increase with the growing population and

*Presented at the Seminar on Regional Imbalance in Agriculture with Special Emphasis on Oilseeds held on November 25, 1986 under the auspices of Indian Science News Association.

**Rasoi Limited, 12, Government Place East, Calcutta-700 069.

affluence. This is being met by imports of oil which results in drain of valuable foreign exchange to the tune of Rs. 1200 crores. The country can ill-afford this and the efforts to curb the imports is highly laudable.

The new thrust brought in by the I.C.A.R. in this direction, the efforts of the technology mission should contribute in a large way for boosting up the oilseed production in the country. By its Geographical situations and preferences of the farmers to cultivate crops which is based on various considerations, the most important being the return he gets for his investment and personal efforts the oilseeds cultivation is centering on different states on different conditions obtaining over there.

If we look back, we find that the practices followed over the years has caused this depressing scene on the oilseeds front. In the euphoria generated due to green revolution efforts of farmers and scientists were centralised on high yielding varieties of cereals while oilseeds were grossly neglected. The major resources of the farmers were diverted to cereals. Out of the total area of oilseeds under cultivation less than 10% is irrigated and very few varieties of oilseeds were developed.

The new determination of the Government and the clearcut guidelines given to the technology mission should give a new dimension to the oilseeds cultivation and herein I would like to emphasise on an individual requirement research and not a blanket technological policy which more often than not, fails. The individual requirement research becomes useful if each of the 180 districts identified by the Technology mission is studied in depth and the following components are introduced into the study :

- (1) adoptive research
- (2) Environmental conservation
- (3) Socio-economic evaluation and feed back.

Here the role of the Krishi Vishwa Vidyalayas who are familiar with the local condi-

tions has to be emphasised many times over. This is the only way to increase involvement of the farmer and technologist and the Government, and increase productivity of crops and efficiency of utilization of resources.

In depth studies of the I.C.A.R. indicate that the general yield levels are low but we do have high yield varieties of oilseeds. The yield ranges of such seeds are far above the national averages. The existing varieties do offer scope for enhancing yield ceiling substantially. How far are these varieties been developed is the question.

It looks as if that adequate quantities of certified seeds has not so far become available to benefit the farmer. Secondly, the cost of the seed being high acts as an impediment to the farmer in using the quantity as per recommendation. Third and most important point in general is that oilseeds are prone to loss of viability fast. Lack of organised seed storage and management system is seriously affecting the crop growth. The supply of proper seeds, storage and management of seed supply appears to be the weakest link in the oilseeds production. This has to be rectified and the authorities have to take bold decision in this regard.

Second is the cultivation of oilseeds in rainfed and irrigated conditions. There has been a great increase in irrigated area to the level of 60 million hectares or so but this has not made much impact.

Third is the tendency to cultivate oilseeds in the marginal and submarginal lands with low productivity potential.

Quoting I.C.A.R. studies again the special reference to the Eastern Region we find that "vast stretches of fertile river banks rising into millions of hectares in Bihar open new vistas of development during post-flood seasons, in rabi season. Safflower, Mustard and Sunflower have excellent scope to develop in these areas."

Similarly in Bihar, again it is found the

inter-cropping system is prevalent. Linseed is cultivated here. The new possibility under this system is for Soybean, Safflower and Sunflower.

Similar conditions exist in Orissa for cultivation of Groundnut and in West Bengal for Groundnut, Rape and Mustard. The cumulative effect of a thrust on these aspects will help us to achieve the targets.

Production of oil by the traditional Screw Press Crushing, the more recent solvent extraction of oils from seeds and oil cakes, the refining of oils to up-grade its quality are subjects which has been talked about—the conventional time-tested methods.

As the times pass-on, it is noticed that Scientific methods can play a very critical role in improving production and productivity. The galloping energy costs which form a vital input in the processing economy of oilseeds and commercial pressures have led to vociferous debates on the State of the industry with the growing realization that high costs of production and consequent 'sickness' are serious impediments on the development of the industry in our extremely competitive market.

Hence modernising the technology is of prime importance and a crying need in the field of oils and fats. Sustained modernization is possible only when we have access to modern technological developments the world over and depend on Research and Development to bring the development useful and cost effective.

The present Governmental policies lends itself to ready access to modern technology from different parts of the world.

One important point to be noted here is that Industry does not lend itself easily to modernisation as long as it has a sheltered life. Only in the case of fierce competition the nerve to modernise in the teeth of the fight to survival takes over and things begin to happen.

When we talk of Modernisation and R & D, we should not lose sight of another

important aspect—productivity and capacity utilisation. The prevalent method of introducing new plant and machinery without reference to efficiency and productivity has to be discouraged at all costs and a clear demarcation of responsibilities of the Project Managers in this regard has to be worked out.

When we talk of capacity utilisation, the matter comes down to availability of raw materials.

Take the case of Oil Mills. The Conventional and Screw presses abound, the efficiencies are minimum and when you see the all India range, the capacity utilisation is in the region of about 45%. Similar is the case of Solvent Extraction plants where the overall average capacity utilisation is about 40% only or even lower. But here there is a paradox. Recently when I was conversing with Dr. K. T. Achaya, the noted Scientist, who is doing a monograph on oil cakes under the aegis of C.S.I.R., he remarked that there is an annual availability of about 50 Lakh tonnes of Oil Cakes which does not get extracted. Here what do we loose? We loose 3 to 4 lakh tonnes of edible oil which is badly required by the country. The only reason why we loose this is the lack of outlets for the extractions for reasons technical and political. It is then imperative that an internal outlet for the extraction is developed, the most important of which is development and propagation of compound cattlefeed for which an intensive education programme for the farmer at the village level is needed.

Such actions and due importance to recovery of oil from minor oilseeds and non-traditional sources will go a long way in meeting the needs of oil. Here it is pertinent to mention that there was a spurt of activity and talk of minor oilseeds about a decade back but since the last five years not only the activity in this sector is minimum but the subject itself lies dormant for reasons beyond the control of the entrepreneur and the industrialist.

Some important suggestions in augmenting supplies of edible oils given by the Oil Technologists' Association of India in 1984, is worth quoting here.

- (1) As a major oilseed crop, Groundnut should receive maximum attention followed by rape/mustard, Sunflower, Safflower, nigre, Soybean.
- (2) Forest Oilseed collection such as Sal, Mowrah, needs to be intensified keeping in mind the ecology aspect. The potential is as high as 15 million tonnes equivalent to 2 million tonnes of oils and fats. Newer resources need exploration.
- (3) Areas of least productivity to sugarcane must be given over for growing oilseeds.
- (4) Encourage organised sector involved in processing of oils to grow their own raw material on fallow lands in a time bound programme over a five year period.
- (5) Genetic engineering in oilseeds development should be encouraged.
- (6) Provide for larger participation by the industry, scientists and technologists in the National Oilseeds Development Board. With this background on the agronomy and agricultural practises which needs the blessings of the Government and the technological thrust required at modernising and introducing energy efficient equipments we may have a quick look at the products and product-mix that the nation might absorb—wherein there is a happy meeting ground of supply and demand tempered by prices that are within easy reach. One way of doing this is to import the cheapest edible oils and make them acceptable to the consumer through proper technology and stretch the current consumption pattern.

Blending of edible oils to make them

more nutritious and flavouring them to improve acceptability. Oils completely unfamiliar to the consumer have been converted to familiar accepted forms by the Vanaspati Industry and herein lies the importance of this industry. The industry needs support in the matter of introducing innovative technologies like interesterification and fractionation to meet the increasing need of raw material supplies.

Low cost spreads and margarines have to be accepted as a reality and steps taken for the manufacture of these by the industry. Talking of margarine it is interesting and useful to draw on developments abroad where very innovative products have been developed. To mention a few :

- (1) Margarine having reduced spattering tendencies in frying wherein margarines are produced with proteins in the aqueous phase which prevent spattering.
- (2) Shelf Stable Margarine mix to be prepared by the consumer. The conventional process of manufacture of Margarine is a costly process involving a considerable degree of capital investment for the equipment. Added to this for a country like India with warm climatic condition, the transport of Margarine may have to be at low temperature. Apart from this refrigeration at the retail level to prevent bacterial growth which is promoted by the high water content in the margarine. For this innovation have been made to prepare Shelf Stable margarine which stay stable under high temperature conditions. Another advantage of this mix is that different tailor made products like Salt-free Margarine or low salt margarine or low sodium salt products can be made.
- (3) Randomized Palm Oil plus vegetable oil products for soft Margarine.

Thus it is seen that the available edible oils can be stretched to a maximum extend

by innovative technologies to meet consumer preferences and demands. Other new products can benefit the confectionary and bread and biscuit industry.

The cause and the remedies are before us. The remedies at the agricultural and will be successful with the patronage of the Government but over a period. The actual period is any one's guess.

The remedies at the technological level will be faster because of availability of the fats—what is needed is decisions at the administrative level permitting industry the freedom to innovate and make acceptable products. Herein according to me lies the immediate solution to this problem of edible oil shortages and the constant yawning gap between supply and demand. It is food for serious thought and deliberation. □

NOTES & NEWS

Nuclear Filters for AIDS Diagnostics

Soviet virologists have developed a new immuno enzyme test for AIDS diagnostics. They did it in close cooperation with physicists who created unique nuclear filters—membranes as yet unprecedented among materials used for filtration.

Only a few cases of AIDS have been registered in the USSR, but the Soviet scientists have already made a significant contribution to the international effort: they have developed a new technique to diagnose AIDS, known as immuno enzyme AIDS test, or IET-AIDS.

The AIDS virus directly attacks a group of white cells (leucocytes) called helped T-cells which serve as one of the main coordinators of the immune system protecting the body from pathogenes and other alien agents. It is very difficult to trace the virus itself. Yet when it has penetrated into the blood, the body begins to produce antibodies, or proteins capable of combining with viruses and checking their proliferation. The IET-AIDS system is based on tracing such antibodies.

A group of researchers from the Institute of Virology, USSR Academy of Medical

Sciences, and the Moscow Research Institute of viral Preparations, USSR Minister of Public Health, devised a "trap" for the antibodies. This is, in fact, a viral antigen, or a set of proteins with which the antibodies combine in the same way as with the AIDS virus inside the patient's body.

The test is simple enough: a blood sample taken from the patient is placed in the hole of a plastic plate coated with antigen. If the blood sample contains antibodies against the AIDS virus, those antibodies will react with the antigen, and the colour of the plate will change.

The existing AIDS tests have one ajorm fault: they tend to show a positive reaction even when the patient's blood is free of AIDS viruses. To reduce such "false alarm" signals, the antigen must be prepared on the basis of an absolutely pure virus. Regrettably, such classical techniques of virus purification as centrifigation or chromatography cannot be used in this particular case because they are complicated, expensive and hardly fit for the mass production of antigens.

Is it possible to purify a great amount of a preparation? Now the nuclear filters have been developed by a group of researchers from the Joint Institute of Nuclear Research in Dubna and the Institute of Crystallography led by Academician Georgi Flerov. Those

filters, or thin plastic (lavsan) films with numerous microscopic holes, usually have pores varying in size from one tenth of millimetre to one thousandth of micrometre. They are perfect in purifying the AIDS virus which is about 0.1 micrometre in diameter. The new type of filter and innovative purification technique developed by physicists jointly with virologists significantly reduced the time of developing the IET-AIDS system. □

Soviet Features

Radiation protection : Towards a unified approach

Although international standards for protection against radiation exposure have been widely adopted, they cannot be easily applied to accidental exposures. In conjunction with other organizations, the IAEA has been working to develop a unified approach to radiation protection that would take into account instances when accidental radiation exposures might arise. At a recent advisory group meeting, experts from Argentina, Canada, Federal Republic of Germany, Hungary, India, Italy, Sweden, Switzerland, United Kingdom, United States, and the International Commission on Radiological Protection (ICRP) met to discuss preparation of a consultative document intended for inclusion in the Agency's *Safety Series* as a guide to Member States.

The ICRP has developed a consistent and coherent set of radiation protection principles that only apply to exposures that are *certain* to occur, such as during normal operation of a radiation facility. Based on these principles, the IAEA, jointly with the World Health Organization (WHO), International Labour Organization (ILO), and Nuclear Energy Agency of the Organization for Economic Co-operation and Development (NEA/OECD), issued the *Basic Safety Stan-*

dards for Radiation Protection (Safety Series 9, 1982). The ICRP principles and *Basic Safety Standards* have been adopted internationally and by most national organizations.

For *probable* exposures, however, the situation is different. So far, this problem has been discussed internationally only in the case of waste repositories. Therefore, generally applicable international recommendations, guides, or norms do not exist that are consistent with the ICRP principles for actual exposures from normal operations.

Procedures for the assessment and control of accidents at nuclear installations, particularly nuclear power plants, have been developed parallel to, and separately from, ICRP recommendations. While the same can generally be said for radioactive waste disposal, ICRP recommendations have been developed and extended to deal with particular problems of wastes.

The work to prepare a safety guide on the application of radiation protection principles to sources of potential exposure, which began in 1985, is one important facet of the Agency's overall programme on radiation protection of the general public and the environment. A final document is expected after the next scheduled meeting of the advisory group in September 1988. □

IAEA Newsbriefs

Installation for Producing New-Class Materials

The Installation of High-Frequency Currents of Leningrad has developed an installation which makes it possible to produce materials of a new class by subjecting metal to powerful thermal shocks.

A 100 gm piece of metal after such treatment can be made into a belt 2.15 kms long. Featuring unique magnetic characteristics, it is capable of storing an enormous amount of computerised data.

This metal can also be made into granules. Cutting tools manufactured from them by extrusion are as strong and corrosion-proof as those including chromium, tungsten and other alloying additives. ☐

Soviet Features

Powerful Telescope Developed

A telescope with a new optical system, developed by a Soviet scientist, makes it possible to discern individual stars in globular clusters and take pictures of them. So far, scientists have been unable to do it for want of adequate optical technology.

The designer of the telescope is Nikolai Fashchevsky, staff member of the Astronomical Observatory of the Odessa University, South Ukraine. He gave up the traditional lenses and introduced a system of mirrors which help widen the sky sector under observation and intercept not only visible light but also ultraviolet, infrared and other emissions.

The telescopic image is clearer and the photo device takes pictures of unknown stars. ☐

Soviet Features

New nuclear plants brought on line in eight countries

In 1986, 21 nuclear power reactors in eight countries were newly connected to the grid, bringing the world's total number of nuclear electricity plants to 394, according to preliminary data available to the IAEA. Nuclear power now accounts for more than 15% of world electricity production. All told, 26 countries generate electricity from nuclear power plants, and in some countries the nuclear share is in the range of 50-70%.

Countries that brought new nuclear power reactors on line in 1986 were Canada (2 were newly connected), Czechoslovakia (2), France (6), Federal Republic of Germany (2), Hungary (1), Japan (1), Republic of Korea (2), and the United States (5). The latest world status of nuclear power plants, based on data available to the IAEA's Power Reactor Information System (PRIS), appears below :

	<i>Reactors/total net MWe</i>
Argentina	2 (935)
Belgium	8 (5486)
Brazil	1 (626)
Bulgaria	4 (1632)
Canada	18 (11 107)
Czechoslovakia	7 (2799)
Finland	4 (2310)
France	49 (44 693)
German Democratic Rep.	5 (1694)
Germany, Fed. Rep. of	21 (18 946)
Hungary	3 (1235)
India	6 (1164)
Italy	3 (1273)
Japan	34 (24 754)
Korea, Rep. of	6 (4475)
Netherlands	2 (508)
Pakistan	1 (125)
South Africa	2 (1840)
Spain	8 (5588)
Sweden	12 (9455)
Switzerland	5 (2932)
Taiwan, China	6 (4918)
United Kingdom	38 (10 162)
United States	98 (83 387)
USSR	50 (27 657)
Yugoslavia	1 (632)

World Total : ● 394 reactors ● 270 333 megawatts-electric (MWe) total net capacity.

IAEA Newsbriefs ☐

Awards Under ISCA Young Scientists Programme

Indian Science Congress Association has introduced a programme for the benefit of young scientists since January, 1981. The programme enables young scientists to present their proposed research work during the annual session of the Science Congress with opportunities to exchange ideas in the relevant scientific problems with their counterparts and specialists. For excellent presentations, 20 such scientists are given awards, called, ISCA Young Scientists Award.

Only members of the Association are eligible for consideration for the Award. The upper age limit of the candidates for the Award is 30 years as on January 1 of the Session.

The details of the programme are given below :

- (1) The papers to be presented for consideration shall have to be :
 - (a) under single authorship, (b) preference will be given for independent work preferably at the post-doctoral level, (c) the work must have carried out in India, and (d) stress will be on both quality of research and performance.
- (2) One copy of the full paper alongwith three copies of its abstract in 100 words (to be clearly indicated on the top of the first page of the full paper and on the top of all the three copies of the abstracts the section where it is

desired to be presented) shall have to reach the office of the General Secretary (Headquarters) *not later than August 16* preceding the Session. Biodata, including full name and address alongwith the date of birth (duly supported by attested copy of the certificate), research experience, *list of publications*, should be appended to the complete paper.

- (3) The papers/abstracts will be scrutinised and the scientists will be required to present their papers in respective sections, if invited by the Sectional Presidents concerned.
- (4) The names of awardees will be announced by the General President at the meeting of the General Body. The Certificate of Merit and the Cash Award of Rs. 500/- will be handed over to the recipients with citations. A further amount of Rs. 2,500/- towards incidentals, etc. will be sent to the awardees later from the Headquarters of the Association as support of the proposed research work.
- (5) The young scientists as recommended by the concerned sections will be provided with the admissible travelling and daily allowances by Indian Science Congress Association (maximum of first class train fare by convenient shortest route to and from residence/institute to venue and daily allowance of Rs. 50/- per day not more than ten days). ☐

LETTERS TO THE EDITOR

Effect of detergent on the nucleolar morphology of the root meristematic cells of *Allium cepa* L.

The change in nucleolar morphology with the changes of RNA synthesis has been reported in Phytohemoglobin stimulated lymphocytes¹. Many studies have been made where RNA synthesis has either been inhibited² or stimulated³ to note corresponding nucleolar changes. But in many of these cases the nucleoli show segregation⁴. The detergent Sodium-Lauryl Sulphate (SDS) has mitastatic effect on the somatic nuclei of *Allium cepa*⁵. The present paper deals with the study of this detergent affecting the nucleolar morphology of *Allium cepa* root meristematic cells.

Onion bulbs with healthy root tips were treated with 0.5% detergent (Sodium lauryl sulphate) at different time intervals (Table 1) and control set was maintained simultaneously all along at room temperature. The root tips were fixed in 1 : 3 acetic alcohol. The tips were squashed in 45% acetic acid and detached in ethanol. Staining was carried out in aqueous Silver nitrate (AgNO₃) solution at a concentration of 1 gm/ml at 60°C for 12 to 14 hours. Observations of nucleolar and nuclear area were made from twenty five cells and the average mean was taken at definite time intervals. The nucleoli and nuclei were drawn with the help of camera lucida, their diameter (long axis and short axis) were measured. The measurements were standardized with the help of staga micrometer. Finally the measurements were put in the formula $S = 11 ab$, where S =nucleolar and nuclear area, a =radius of long axis, b =radius of short axis.

TABLE 1 : Showing the average nucleolar and nuclear area per cell (μ) of detergent treated and control sets at different time intervals

S. No.	Time of treatment	D/C	Average nucleolar area per cell in μ	Average nuclear area per cell in μ	Ratio $\frac{Nu}{No}$
1	10 minutes	D ₁	17.22*	115.9	6.73
		C ₁	25.37	138.16	5.44
2	20 minutes	D ₂	16.96**	93.33	5.50
		C ₂	20.04	121.64	6.60
3	30 minutes	D ₃	10.96*	41.45	3.78
		C ₃	19.64	80.11	4.08
4	1 hour	D ₄	7.97**	42.71	5.40
		C ₄	12.36	66.39	5.37

D—Detergent ; C—Control ; Nu—Nuclear area ; No—Nucleolar are ;

*—Significant at 5% level, **—Significant at 1% level

Figures 1 to 4 showed the different types of morphology of nucleoli in the root meristematic cells of *Allium cepa* during the investigation. They were deep brown to black after silver staining whereas the nuclear area stained light yellow colour. Figures 1 and 2 showed more or less round nucleoli in twenty minutes detergent treatment and control respectively. Figure 3 showed pear shaped nucleolus in twenty minutes time of detergent treatment. Figures

4 and 5 showed dumbbell shaped and three nucleoli in ten minutes and one hour detergent treatment respectively. From the measurements of nuclear and nucleolar area it was observed that there was a gradual decrease in the area of nucleus and nucleolus (Table 1) with an increase in time interval in both detergent treated and control sets. However, the decrease of area in detergent treatment was markedly more than that of the control set.



Figs. 1-5. (1) Showing more or less round nucleoli in twenty minutes detergent treatment. Mark the size difference also. X 825; (2) Showing more or less round nucleoli in twenty minutes control treatment. X 825; (3) Showing one pear shaped nucleolus and one elongated in twenty minutes detergent treatment. X 825; (4) Showing dumbbell shaped nucleoli in ten minutes detergent treatment. X 825; (5) Showing three nucleoli in one hour detergent treatment. X 825.

TABLE 2 : Showing the percentage of different morphological types of nucleoli of detergent treated and control sets at different time intervals

D/C	Time of treatment	% of Elongated shape	% of Dumbbell shape	% of pear shape
D ₁	10 min.	—	0.48	0.73
C ₁	10 min.	—	0.34	—
D ₂	20 min.	4.2	1.06	2.13
C ₂	20 min.	0.76	0.92	—
D ₃	30 min.	1.71	1.88	1.46
C ₃	30 min.	0.42	1.28	—
D ₄	1 hr.	1.25	2.26	1.42
C ₄	1 hr.	0.96	1.92	—

D stands for Detergent ; min. stands for minutes and hr. for hour
C stands for Control

Regarding the morphology of nucleoli round, oval, elongated, dumbbell shapes were found frequently in treated and control sets. Pear shaped ones were completely absent in control sets (Table 2). Number of nucleoli was usually two, occasionally one after fusion, rarely three. Size differences of nucleoli in detergent treated nuclei were also noteworthy compared to control (Figures 1 and 3).

Silver staining methods have been widely used for the detection of nucleolar organizing regions in various organisms⁶. From the previous experimental evidences⁷ it has been clear that these nucleolar organizing regions which are actively engaged in the synthesis of r-RNA could be stained by Silver and Silver staining patterns reflect the functions of ribosomal genes rather than their mere presence⁸. Schwarzacher *et al.*⁸ made it clear that silver granules are mainly associated with fibrillar component at the nucleolus. Hofgartner⁹ demonstrated a positive direct correlation between the

amount of Silver precipitate over the nucleolar regions and the rate of r-RNA synthesis. From the figures and table 1 it is clear that with increase in time of treatment (both in detergent and control) there was a gradual decrease in the area of the nucleolus and nucleus indicating the fall in the value of r-RNA synthesis as well as nuclear activity. t test on the nucleolar area of the detergent treated and control sets showed that decrease was quite significant. It might be inferred that the detergent had definite effect on the nucleoli and most probably causes inhibition of r-RNA synthesis i.e. inhibition of nucleolar activity. Previous report of Sen and Bhattacharya⁵ on the mitotic activity of *Allium cepa* showed that this detergent was found to cause mitotic inhibition. Dupraw¹⁰ in his review paper stated that nucleolar size is a reliable indicator of nuclear activity and RNA synthesis. Experimental evidences showed that removal of the nucleolus organizing region may lead to abnormal behaviour often resulting in

the death of the cells. The similarity between the base ratios of nucleolar and ribosomal RNA, the ready hybridization between ribosomal RNA and DNA of the nucleolar region showing that they are complementary to each other in the nucleotide sequence, the drastic impairment of protein synthesis in a cell containing a non-nucleolar nucleus after the supply of ribosomal RNA, embryonic death of the mutant forms without a nucleolus organiser in the African clawed toad, *Xenopus*, are the established evidences¹¹. This is presumably because the organiser is one of the active sites for the formation of the ribosomal RNA without which the life span of the cell is limited. Regarding the fall in the value at nuclear and nucleolar area in the control set it might be inferred that such effect was due to transfer of roots from *in vivo* to *in vitro* condition i.e. from natural to artificial condition. Such environmental change may cause a metabolic change within the cells of the roots affecting the nucleoli too. When onion bulb epidermal cells are activated by exposure of turbid leaf bases to ambient atmosphere nucleoli in cells adjacent to wound sites enlarge within three hours and change their shapes from round to oval and elongated oval and finally form dumbbell shaped nucleoli⁸. The study of pachytene nucleoli showed the presence of one or more usually two nucleoli¹² in which the two nucleoli are closely linked and differ considerably in size. The difference in size between the two paired nucleoli may lie in some dominant recessive relationship between the two organisers¹³, an observation which tallied with previous report regarding the inhibition of function of a weak nucleolar organiser by a strong one in certain species of plants and animals¹⁴.

The present investigation showed clearly that in *Allium cepa* root meristematic cells have two nucleolar organizers responding differently to the detergent treatment causing

probably a change in morphology as well as in number or splitting of nucleolus may be responsible for increase in number since three nucleoli were absent in control but found occasionally in detergent treatment (vide figure 5).

Intense staining with silver required higher amount of nucleolar activity at fibrillar component of the nucleoli, this is evident in cells showing higher rate of RNA synthesis. These cells have largest nucleolar area too. On the other hand cells showing lowest rate of RNA synthesis show lower intensity of the nucleolar staining, a somewhat ring shaped appearance of the nucleoli and the lowest nucleolar area. The ring shaped nucleoli are very common in nature and in differentiated animal cells as human lymphocytes, plasmacytes, monocytes etc¹⁵. Liver cells show nucleolar enlargement when starving animals are refed¹⁶. Interferometric measurements indicate that there is a corresponding increase in RNA content of the nucleoli. Liver cells of senile mice and man¹⁷ showed ring shaped nucleoli. Such nucleoli are also produced in cells where RNA synthesis is inhibited⁸. The nucleolar size and number may change with nucleolar fusion and simultaneously it is shown that often in the early S-phase the nucleoli do not grow in size except by fusion¹⁸. Further critical study on the detergent effect on the nucleoli is necessary for getting more information.

The present investigation is financed by the Kalyani University as personal research grant to SB and as research fellowship to O.S.

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Received : 1 October, 1986.

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The effect of alcohol plant effluent and a few herbicides on oxygen consumption in *Daphnia pulex*

Oxygen consumption is a useful measure of sublethal effects because energy process serve as an indicator of overall physiological reactions.¹ The present study is an attempt to explore the effect of effluent of Ratlam Alcohol Plant, Ratlam (M.P.) India and four herbicides—Atrataf (Atrazine) AC-92,553 (Pendimethalin), TOK (Nitrofen) and Lasso (Alachlor) on the oxygen consumption in *Daphnia pulex*, a fresh water animal. Toxicity of some industrial wastes to fish was previously studied.² Herbicides are widely used and due to direct application reach

water ways.³ The effect of 2, 4-D and 2, 4, 5-T on oxygen consumption of *D. pulex* was studied earlier.⁴

D. pulex were cultured in a glass trough using tap water. They were feed yeast daily and transferred to petridishes for acclimation⁵. The effluent was taken from the anaerobic lagoons of Ratlam Alcohol Plant. The sources of four herbicides were : Cyanamid India Ltd. (AC-92,553), Rallis India Ltd. (Atrataf), Monsanto Co. Ltd. (Lasso) and Indofill Chemicals Ltd (TOK). Fresh solutions/suspensions of 0.5, 1.0 and 2.0 ppm of each herbicides and 25, 50 and 75% dilutions of effluent were prepared from the tap water, just before starting the experiment. Oxygen consumption was measured by pipette manometer using 1.0 ml water or respective solutions with five *Daphnia*. Readings were taken at 5 minutes intervals over a 15 minutes period at $28 \pm 1^\circ\text{C}$ water temperature and $35 \pm 1^\circ\text{C}$ room temperature for different runs.

Neither temperature nor dose had a significant effect on oxygen consumption for *D. pulex* exposed to 2, 4-D⁴. A definite trend in case of effluent (Table 1 and Fig. 1),

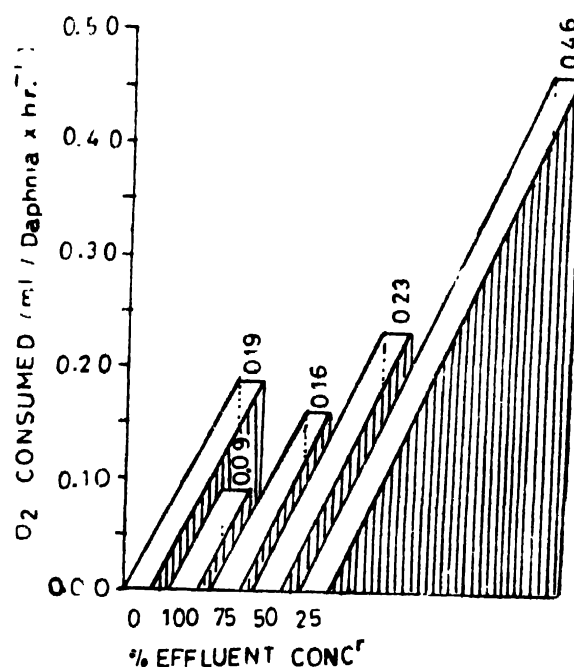


Fig. 1. Mean oxygen consumption (ml/Daphnia × hour⁻¹) in *D. pulex* exposed to effluent of Alcohol Plant

TABLE 1 : Mean oxygen consumed (ml/5 Daphnia) by *D. pulex* exposed to effluent of Ratlam Alcohol Plant

Time	Effluent concentrations				
	Control	100%	75%	50%	25%
First 5 Minutes	0.12	0.11	0.11	0.15	0.31
Next 5 Minutes	0.08	0.00	0.07	0.10	0.20
Last 5 Minutes	0.04	0.00	0.02	0.02	0.07
Total 15 Minutes	0.24	0.11	0.20	0.27	0.58

AC-92,553 and Atrataf (Table 2 and Fig. 2). The trend was that oxygen consumption increased with increase in concentration of AC-92,553 solution. Report exist with regard to the gene-

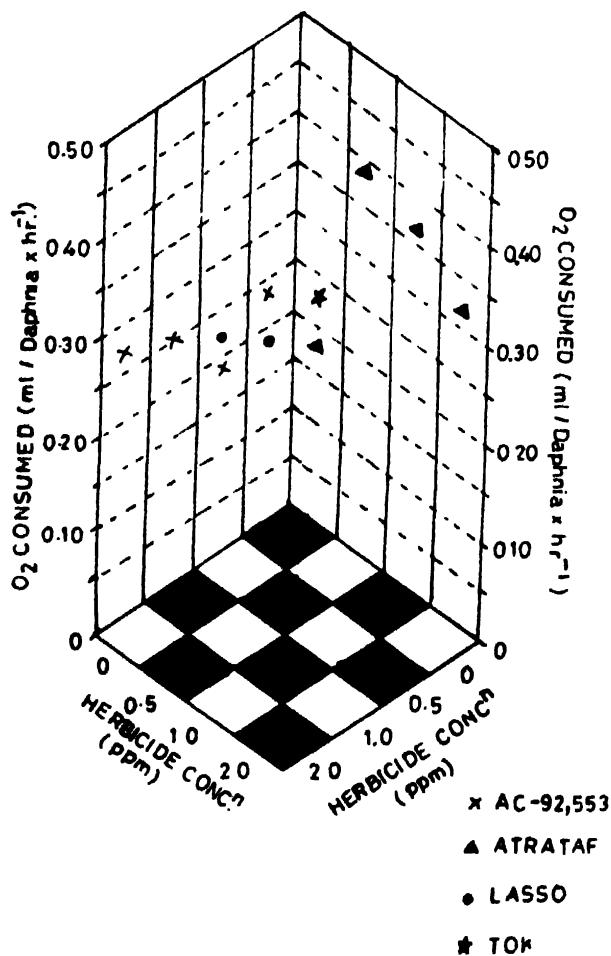


Fig. 2. Mean oxygen consumption (ml/Daphnia x hour⁻¹) in *D. pulex* exposed to four herbicides of different concentration

TABLE 2 : Mean Oxygen consumed (ml/5 Daphnia) by *D. pulex* Exposed to Four Herbicides

Time (min.)	HERBICIDES CONCENTRATIONS (PPM)											
	AC-92,553				Atrataf				Lasso			
	0	0.5	1.0	2.0	0	0.5	1.0	2.0	0	0.5	1.0	2.0
First 5 min.	0.20	0.14	0.14	0.16	0.14	0.23	0.22	0.18	Nil	0.15	Nil	Nil
Next 5 min.	0.07	0.16	0.11	0.14	0.06	0.16	0.13	0.14	Nil	0.07	Nil	Nil
Last 5 min.	0.02	0.03	0.06	0.04	0.03	0.10	0.12	0.08	Nil	0.06	Nil	Nil
Total 15 min.	0.29	0.23	0.31	0.34	0.23	0.49	0.47	0.40	Nil	0.28	Nil	Nil

ral trend of increased respiration in 2, 4-D and 2, 4, 5-T experiments.⁴ With effluent there was a trend of increase in respiration with the decrease of effluent concentration. At 25% effluent concentration, rate of oxygen consumption was very high. The effluent contains spent wash and waste water, having very high B.O.D., C.O.D., biodegradable dissolved solids and high concentration of chloride, potassium, calcium and sulphate ions with acidic nature.⁵ In Lasso, although respiration was higher at 0.5 ppm solution than control, but respiration was fully checked at 1.0 and 2.0 ppm solutions. In case of Atrazine, *Daphnia* respired highest at 0.5 ppm concentration and respiration decreased with increase in concentration. Depression in respiration in another crustacean at higher concentrations of herbicides has already been observed¹. TOK was observed to be very lethal for *Daphnia*, because animals died when exposed to 0.5 ppm solution of the herbicide. One thing is notable that *D. pulex* died at higher concentration (than 2.0 ppm/75%) in each case irrespective of the herbicides or the effluent. The physiological basis for the effect of herbicides on respiration is not known. It has been reported that neurotoxins increase spastic muscle activity and cause an increase in oxygen consumption but when sufficient levels are present to cause some cell death, depression of oxygen consumption results.⁶ But the physiological systems important in the response have not been identified.

Authors acknowledge financial assistance of DOEn, New Delhi and Laboratory facilities from Head, School of studies in Botany, Vikram University, Ujjain.

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Received : 14 April, 1986.

Revised : 8 January, 1987.

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Two new species of the genus *Spirogyra* Link from eastern India

Since the publication of the monograph on Zygnemaceae¹, 13 new species of the genus *Spirogyra* Link have so far been described²⁻¹² from various parts of this country. Most of them are reported from Punjab and Uttar Pradesh. It appears from available literature¹³⁻¹⁹ that the work done on this genus from eastern India is insignificant. During present survey of algal flora of some parts of Bihar and West Bengal, the authors came across many interesting specimens of the group. In the present communication, only two new species here are described (*S. bardhamanensis* sp. nov. and *S. darbhangesis* sp. nov.)

Spirogyra bardhamanensis sp. nov. (Figs.1-3)

Vegetative cells 14-18×66-175 μm ; end wall plane · chloroplast 1-2, making 2-4 turns ; conjugation scalariform ; conjugation tubes formed by both gametangia ; receptive gametangia inflated (29-34 μm) on both sides ; male gametangium cylindric, zygospores ellipsoid, 24-29×49-58 μm, median spore-wall punctate, yellow-brown.

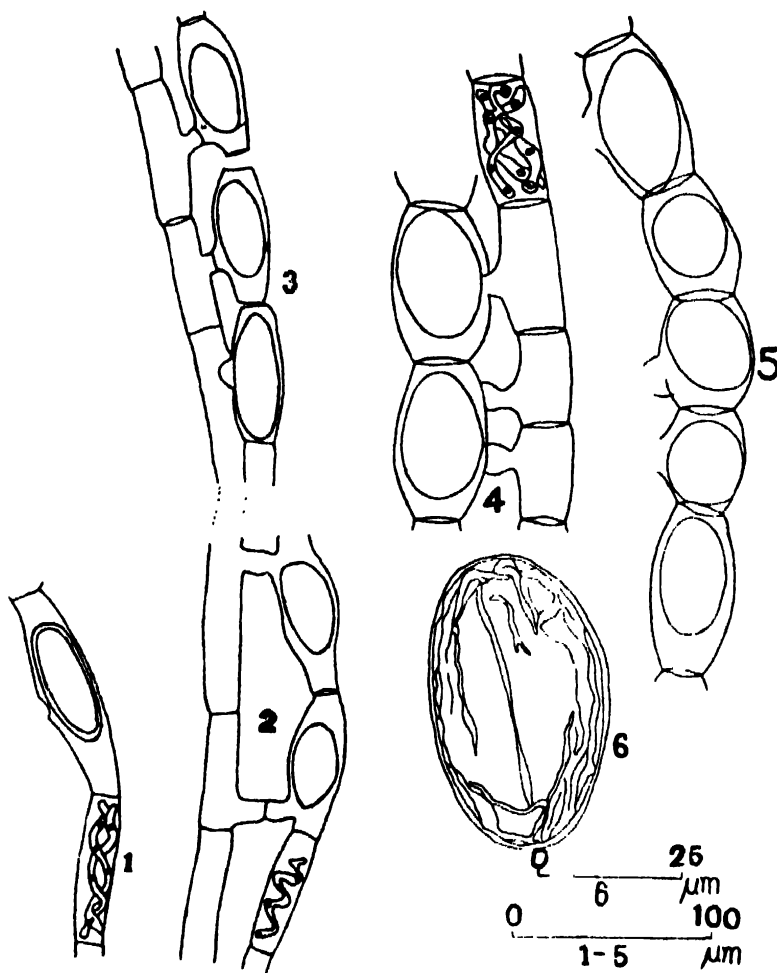
Type locality : A pond in Bardhaman, West Bengal, India, September 1981.

Type specimen : AKG-59 is deposited in the Botany Department, C. M. Science College, Darbhanga, India.

Latin diagnosis: Cellulae vegetativae $14-18 \times 66-175 \mu\text{m}$; parietes terminalis plani; chloroplastis 1-2, anfractibus 2-4 in cellulae, conjugatio scalariformis, tubi formanti of duobus gametangium

C. M. Sc. College, Darbhanga, India deposita.

This new species approaches *S. Lagerheimii* Wittrock in all respects except that it has smaller cells instead of bigger ones, 1-2 chloroplast constantly occurring instead of only one, conjugation usually scalariform instead of usually lateral and zygospores of lesser dimension.



Figs. 1-6 : (1-3) *S. bardhamanensis* sp. nov. ; (4-6) *S. darbhagensis* sp. nov.

foemineum inflatum ($29-34 \mu\text{m}$) in ambobus lateribus; gametangium masculum cylindricum; zygosporae ellipsoideae, $24-29 \times 49-58 \mu\text{m}$, sporae paries medianus punctatus, luteo-brunneus.

Locus typi : Lacuna in loco Bardhaman, West Bengal, India dicto, m. September 1981.

Specimen typi : Materia typica (AKG-59) in Departamento Botanico,

Spirogyra darbhagensis sp. nov. (Figs. 4-6)

Vegetative cells $29-33 \times 54-92 \mu\text{m}$; end walls plane; chloroplast usually 3; rarely 2; conjugation scalariform, conjugation tubes formed by both gametangia; male gametangia cylindric; receptive gametangia inflated ($42-45 \mu\text{m}$) on both sides; zygosporae polymorphic, varying from globose to ovoid to ellipsoid, $41-46 \times 54-71 \mu\text{m}$; median spore-wall wrinkled with prominent ridges, brown.

Type locality : A pond "Horai Pokhra" in Darbhanga (Bihar), India, March 1985.

Type specimen : AMV-122 is deposited in the Botany Department, C. M. Science College, Darbhanga, India,

Latin diagnosis : Cellulae vegetativae $29-33 \times 54-92 \mu\text{m}$; parietes terminales plani, chloroplastis plarumque 3, raro 2, conjugation scalariformis; tubi formanti a duobus gametangiis; gametangium masculum cylindricum, gametangium foemineum inflatum ($42-45 \mu\text{m}$) in quoque latere; sporae paries medianus grosse rugosus.

Locus typi : Lacuna "Horai Pokhra" in loco Darbhanga (Bihar), India dicto, m. March, 1985.

Specimen typi : Materia typica (AMV-122) in Departamento Botanico, C. M. Science College, Darbhanga, India deposita.

The present specimen approaches *S. exillis* var. *crassa* Rattan¹⁰ but differs from the latter in having wrinkled median spore wall.

We are thankful to Professor P. Sarma, Ph.D. (Auck.), F.L.S. (Lond.), The University of Burdwan, West Bengal and Professor J. P. Sinha of Ranchi University, Bihar for constant encouragement. Latin diagnoses of the new species by Dr. N. C. Mazumdar, B. S. I., Dehradun are thankfully acknowledged.

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Received : 6 October, 1986.

Revised : 23 April, 1987.

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Growth rate in infant estuarine crocodile *Crocodylus porosus*

The estuarine or saltwater crocodile (*Crocodylus porosus* Schneider) is one of the highly endangered reptilian species. It has been listed in Schedule I of the Wildlife (protection) Act, 1972. Since then, an attempt is being made to increase the number of these crocodiles. One such attempt is in progress at the Bhagabatpur Crocodile Project Centre, Sunderbans, West Bengal, India. As per programme, a good number of eggs of *C. porosus* were collected from their natural habitat of the Islands of Sunderbans in June 1982 and 1983. The eggs were placed carefully inside the hatchery constructed for the said purpose

in the campus of Project area. The eggs hatched after 72 and 79 days in 1982 and 1983 respectively. The hatchlings were maintained properly in hatchling pools for a period of one year. The yearlings were maintained in yearling pools till the day of release into the Bay of Bengal. They were supplied with minced and live prawns, fish fry, crabs, chopped fish in excess. During the period, data on the growth in body length and weight were taken at irregular intervals which are presented in this note.

In 1982, the hatchlings (a total of 24) of August 14 added 59.3 cm in their body length and 2.427 kg within a period of 17 months, i.e. on January 14, 1984. At the time of release, at an average age of 27 months they were 1.2 m in length and 4.65 kg in weight. In 1983, the hatchlings (a total of 39) on the day of hatching i.e. on August 17, were, on the average 27.6 cm in body length and 68.0 gm in weight. They attained 41.8 cm in length and 273.0 gm in weight by November 11 in the same year. The growth rate was little bit slow during December 1983 and January 1984 period due to the fall of temperature (the range of minimum temperature was 9-17°C). On January 11, 1984 the average body length and body weight of the hatchlings were 43.29 cm and 300.7 gm respectively. After that, no record was maintained on the growth rate but the hatchlings were maintained properly. In the last week of August 1984, they were transferred to yearling pools. The yearlings grew to a considerable degree and by September-November period in 1985 they attained the release size i.e. 1.2 meters in body length. At this time, they were 4.61 kg (average) in weight.

Though crocodiles have drawn our attention for a long time, no systematic account on the rate of growth is still available. However, according to Biswas¹ 1½ year-old *C. porosus* were, on the average 92.05 cm in length and 2.6 kg in weight while those of 2½ year-old individuals were 118.6 cm

in length and 5.18 kg in weight when they were received from the Saltwater Crocodile Conservation and Research Station, Dangmal (Bhittar Kanika Wildlife Sanctuary), Orissa for releasing them into the pools at the Nandankanan Biological Park, Orissa for further studies. The present findings are almost in agreement with the reports presented by Biswas.¹

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Toxicity of certain fungal strains isolated from mandarin oranges

A large number of micro-organisms pathogenic to plants are known to elaborate toxic metabolites¹, many of which are host specific². Some of these metabolites have been found to be toxic to micro-organisms as well as animals. *Alternaria alternata* has received considerable attention in this respect³. A strain of *A. alternata* (Fr.) Keissel has been isolated in this laboratory from diseased mandarin oranges⁴. Two more organisms, *Geotrichum candidum*⁵ and *Phyllosticta citricarpa* have been isolated (unpublished data). All the three organisms have been found to be pathogenic to several fruits including mandarin oranges.

Organisms were maintained on potato-dextrose-agar slants and spore/mycelial

TABLE 1 : Effect of feeding culture media inoculated with *A. alternata*, *P. citricarpa* and *G. candidum* on albino rats and mice

Exptl. animal medium	Organism	Average wt/animal ^a (g)							Average died intake/animal (g)						
		Days							Days						
		0	3	5	7	15	3	5	7	15	3	5	7	15	3
Mice	1% Control ^b	29.10	31.50	34.00	—	—	—	—	—	—	1.98	2.95	—	—	—
	<i>A. alternata</i>	29.50	25.50(1)	25.17(3)	—	—	—	—	—	—	6.50	3.07	—	—	—
	<i>G. candidum</i>	30.60	31.50	31.10	—	—	—	—	—	—	4.00	5.00	—	—	—
	<i>P. citricarpa</i>	29.90	29.40	29.80	—	—	—	—	—	—	3.40	4.80	—	—	—
Rat	1% Control ^b	19.25	21.25	—	22.25	25.85	3.50	—	3.00	6.80	—	—	—	—	—
	<i>A. alternata</i>	21.00	16.50	—	14.00	14.80	2.85	—	4.94	4.20	—	—	—	—	—
	<i>G. candidum</i>	20.00	21.25	—	25.00	30.15	3.25	—	4.65	7.15	—	—	—	—	—
	<i>P. citricarpa</i>	19.00	16.00	—	20.25	23.15	2.65	—	2.95	5.15	—	—	—	—	—
Rat	5% Control ^b	25.80	31.15	—	34.80	41.35	2.50	—	4.10	7.15	—	—	—	—	—
	<i>A. alternata</i>	25.10	26.30	—	27.70	28.80	4.13	—	5.10	6.00	—	—	—	—	—
	<i>G. candidum</i>	25.10	30.30	—	35.40	42.80	4.80	—	5.00	8.18	—	—	—	—	—
	<i>P. citricarpa</i>	25.20	18.40	—	22.60	24.75	2.15	—	1.80	3.10	—	—	—	—	—
Rat	10% Control ^b	40.75	44.22	—	55.37	72.22	6.06	—	6.55	8.75	—	—	—	—	—
	<i>A. alternata</i>	40.12	33.75	—	34.50	40.00	2.00	—	1.75	3.10	—	—	—	—	—
	<i>G. candidum</i>	39.62	48.00	—	58.12	74.00	8.55	—	9.55	9.55	—	—	—	—	—
	<i>P. citricarpa</i>	41.00	37.62	—	52.37	64.00	10.00	—	12.50	11.55	—	—	—	—	—
Rat	30% Control ^b	41.62	46.00	—	58.12	74.75	6.55	—	6.00	9.15	—	—	—	—	—
	<i>A. alternata</i>	41.75	43.22	—	51.12	63.37	6.00	—	10.10	9.20	—	—	—	—	—
	<i>G. candidum</i>	42.12	46.22	—	53.75	65.62	8.05	—	11.05	11.15	—	—	—	—	—
	<i>P. citricarpa</i>	41.62	43.81	—	51.12	62.62	7.00	—	9.00	12.25	—	—	—	—	—

^a Four young albino rats per group and five young albino mice per group.^b Control was air dried ground rice medium which was inoculated with sterile water.^c Parentheses indicate total no. of animals dead on that day since the start of experiment.

suspension was prepared in 10 ml sterile distilled water and used as inoculum. Rice medium was used for growth and toxin production⁶. Control flasks were inoculated with sterile distilled water⁶. Incubation period was 28 days at $25 \pm 2^\circ\text{C}$. In animal feeding experiments, air dried and ground culture was used³. To study the effect of toxins on seed germination, toxins were extracted and partially purified by the procedure described by Stinson *et al.*⁷ with some modifications. For antibacterial studies toxins were extracted by method of Sauer *et al.*³

Young mice and albino rats were used in animal feeding experiments. The dried-ground culture medium was mixed with normal laboratory diet (Hindustan Levers Gold Mohur Rat diet). Sterile water inoculated rice medium was dried and mixed with normal laboratory diet of control groups. Animals were given water and food *ad libitum*. They were weighed daily at 11.30 A.M. and were closely watched for any overt symptoms⁸. In germination experiments, of toxin solution was added in petriplates containing surface sterilised seeds. Degree of germination was determined periodically for 5 days. Paper-disc-agar plate method was used to determine the effect of toxic metabolites on a number of bacteria and yeasts.

Table 1 indicates the effect of diet containing toxins on mice and rats. In these animals, all the three organisms were toxic, *A. alternata* showing highest toxicity. Studies of Meronuck *et al.*⁹ have shown that a large number of *A. alternata* isolates produce Tenuazonic acid (TeA). Purified AOH and AME in 1:1, combination and AOH alone have also been reported to show foetotoxic and teratogenic effects in mice^{9,10}. Sauer *et al.*³ have further suggested that Altertoxin also contributes to the toxicity in mammals. It thus appears possible that the present strain of *A. alternata* produces atleast a few of these toxins.

Toxins isolated from all the three organisms inhibited germination of seeds (wheat,

soybean), *P. citricarpa* being most potent in this regard. Umetsu *et al.*¹¹ have observed a remarkable stunting effect of TeA (Tenuazonic Acid) on rice seedlings at 50 ppm level. It was also observed during the present study that toxins of *A. alternata* are highly toxic to *E. coli*, *Bacillus* species, *P. vulgaris*, *A. aerogenes*, *S. lutea*, *C. utilis*, *S. aureus* and *Psu. auregiosa*. *G. candidum* was mildly toxic to *A. aerogenes*, *S. lutea* and *S. aureus* and *P. citricarpa* was toxic to *S. lutea*. Toxicity of toxins extracted from a strain of *A. alternata* to a number of micro-organisms has been reported by Pero *et al.*⁶ Further work on purification and characterization of these toxins is in progress.

Financial support of Indian Council of Agricultural Research (ICAR) is greatly acknowledged. The authors also thank Prof. H. F. Dagainawala, Head of Department of Biochemistry and Microbiology, Nagpur University, for his interest in this work.

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Received : 31 March, 1986.

Revised : 29 April, 1987

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Response of early rice varieties to levels of nitrogen under dryland conditions

Rice, a major kharif crop of Rewa division, is mostly cultivated under rainfed conditions. Tall variety 'Dihula' is the traditional variety in this region due to its early maturity and tolerance to drought, but its productivity is low. Hence, an attempt was made to compare the performance of some early genotypes of rice along with 'Dihula'. It was also an aim to find out economical dose of nitrogen for higher production under rainfed condition.

The trial was laid out in split plot design, keeping five levels of nitrogen (0, 20, 40, 60 and 80 kg/ha) in main plots and four varieties of rice (Dihula, cauvery, DR-92 and IR-28) in subplots with three replications. Nitrogen was applied as per treatment in three splits, i.e. 25% at sowing, 50% at tillering and 25% at panicle initiation stage. Crop was sown on July 16, 1984 in plot size of 5.0 m × 3.6 m with 20-cm row-to-row distance. At maturity, a net plot of 4.0 m × 3.2 m was harvested to record the grain yield. The yield components were recorded from ten randomly selected plants per treatment.

Increasing levels of nitrogen significantly increased the grain yield (Table 1). The highest grain yield (25.0 q/ha) and net income Rs. 1059.6/ha) was obtained from 80 kg N/ha. However, the difference in grain yield between 60 kg and 80 kg N/ha was not significant, but both were found significantly higher than 40 kg N, 20 kg N and control.

Increase in grain yield under 60 and 80 kg

TABLE 1 : Response of early rice varieties to levels of nitrogen on grain yield and its attributes

Nitrogen level (kg/ha)	Plant height (cm)	Tillers/plant	Panicles m ²	Panicles plant	Panicles length (cm)	Percentage filled grain	Grain yield/plant (gm)	Grain yield (q/ha)	Net income (Rs./ha)
0	55.0	1.6	361.3	1.5	14.8	76.6	0.9	10.1	-203.4
20	63.3	1.9	419.0	1.6	16.2	78.8	1.3	16.0	349.4
40	66.0	2.2	487.0	1.9	16.2	79.6	1.4	18.3	505.6
60	69.6	2.7	593.0	2.5	17.7	80.9	1.8	22.9	895.3
80	71.5	2.4	587.7	2.3	17.4	79.6	1.5	25.0	1059.6
C.D. 5%,	5.8	0.34	86.6	0.4	0.9	N.S.	0.5	4.11	
<i>Variety</i>									
Dihula	76.2	2.5	573.1	2.2	15.0	77.7	1.0	18.5	507.7
Cauvery	54.8	2.0	450.7	2.0	15.9	73.9	1.3	13.5	-21.8
DR-92	59.3	2.2	435.7	2.0	15.8	79.5	1.6	15.9	215.9
IR-28	70.1	1.8	498.9	1.8	19.4	85.5	1.6	25.9	1389.5
C.D. 5%	3.1	0.32	74.7	N.S.	1.0	7.3	0.4	2.14	

N/ha may be attributed to the significant increase in plant height, tillers/plant, panicles/m², panicles/plant, panicle length and grain yield/plant. The increase in grain per kg of nitrogen between 0-20, 20-40, 40-60 and 60-80 kg nitrogen range were 29, 11, 23 and 10 kg respectively.

IR-28 recorded significantly higher grain yield (25.9 q/ha), followed by Dihula and DR-92. The lowest grain yield was observed in Cauvery. Only IR-28 was significantly superior in yield than locally adapted Dihula and gave the highest net return (Rs. 1389.5/ha). The highest grain yield of IR-28 may be due to significant increase in yield components namely panicles/m², panicle length, percentage filled grain and grain yield/plant. It may be concluded that IR-28 may replace the locally adapted rice variety Dihula. A nitrogen level 60 to 80 kg/ha may be applied to get higher production.

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Record of *Telenomus (Aholcus)* sp. nr. *incommodus* Nixon on citrus butterflies, *Papilio* spp.

New flushes in citrus nursery and field are extensively damaged by larvae of citrus butterflies, *Papilio demoleus* L. and *P. polytes* L.¹ The egg stage of the pest is attacked by many parasitoids viz., *Trichogramma evanescens* Westw., *T. chilonis* Ishii, *Telenomus* sp. and *Pteromalus luzonensis* L.^{1,2}. Adults of *Telenomus* recovered from the field collected eggs of *Papilio* spp. during 1984-86 were got identified as *Telenomus (Aholcus)* sp. nr. *incommodus* Nixon (Hym., Scelionidae). It is for the first time recorded as a parasitoid of *P. demoleus* and *P. polytes*.

The activity of the parasitoid, *Telenomus* was observed throughout the year but more parasitism was observed during the months of December to May at Indian Institute of Horticultural Research Farm, Hesseraghatta, Bangalore. It had produced as high as 78.29 and 71.43 per cent parasitism during the month of Feb., 1985 and 1986 respectively.

T. sp. nr. incommodus readily parasitized one to 2 day old eggs of *papilio* spp. under laboratory conditions and development was completed in 11.18 days at 27 ± 2°C. Adults upon emergence mated readily. Males were smaller than females. Antennal character can easily be used to sex male and female. The adults survived for 8.2 days when fed with 40% honey solution. Each parasitized egg of *Papilio* spp. yielded 1-3 adults and super parasitism was common. The sex ratio was found to be 1 : 2.5 ; in favour of more of female production.

The author is grateful to Dr. A. Polaszek, Commonwealth Institute of Entomology, London for identifying the specimens.

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Note on carbofuran residues in pointed gourd (*Trichosanthes dioica* Roxberg) and its soil

Pointed gourd (*Trichosanthes dioica* Roxberg) one of the remunerative cucurbitaceous vegetable crop grown extensively in Gujarat is reported to be infested by vine borer

Apomecyna neglecta Posc.¹, leaf eating caterpillar *Plusia peponis* F.², mealy bug *Ferrisia virgata* (Ckll.) and scale *Chloropulvinaria* sp. (unpublished). Farmers of south Gujarat use carbofuran 3 per cent granules to be applied in soil for the control of sucking pests particularly mealy bugs and scale insects. However, no work has been done on the extent of carbofuran residues in the fruits of this vegetable crop and in its soil under Indian agroclimatic condition. Hence, the present investigation on extent of carbofuran residues in the fruits of pointed gourd plant and its soil was carried out in Gujarat and the results are reported here.

A field experiment was conducted in the farmer's field having silty to clayey soil at the village Tankal of Chikhli taluka in Valsad district of Gujarat. The experiment was carried out from March to May, 1984 in the plot having 2500 pointed gourd plants per hectare, spaced at 2 x 2 m distance. Three treatments of carbofuran (FURADAN) 3 G viz., 0.5 kg a.i./ha (6 g/plant), 1.0 kg a.i./ha (12 g/plant) and 1.5 kg a.i./ha (18 g/plant) were selected for the study and each treatment was applied to 25 isolated pointed gourd plants. The granules were applied in the soil in ring fashion about 6 inches away from plant during fruiting period.

For the residue study, the fruit samples from each plant were taken randomly at 15, 30 and 45 days after treatment (DAT), pooled treatmentwise, chopped finely and finally representative sample (20 g) was taken from each treatment on each day of sampling and analysed for carbofuran residues. The soil samples were collected 90 DAT from 15 different spots in each treatment upto a depth of 5-10 cm with the help of metal scoop. These samples were dried at room temperature and ground to pass through 2 mm sieve. Soil samples each weighing 100 g was taken for the analysis of carbofuran residues separately.

The method of analysis was essentially the same as that of Cook³. Twenty grams

of the finely chopped fruit samples were hydrolysed by refluxing in 250 ml of 0.25 N HCl for one hour and filtered. The filtrate, after cooling was repeatedly extracted with 100 ml redistilled dichloromethane and the extract was passed through a layer of anhydrous sodium sulphate. The extract was further concentrated to 50 ml with a jet of warm air after adding a drop of propylene glycol. It was then passed through a silica gel-activated carbon-activated alumina column chromatographic clean up step, eluting the insecticide with 1 + 5 (v/v) : ethyl acetate + dichloromethane mixture. The eluate was evaporated to dryness, dissolved in 2 ml acetone, and 2 µl of this solution was injected into the gas chromatograph (Varian G.C. series 3700) equipped with a thermoionic specific detector. The operating condition were : Column 185°C, injector 255°C and detector 263°C. Column consisted of 50 cm long, 3 mm i.d. stainless steel tube packed with 5% OV-101 Gas chrom Q 60/80 mesh. The column was conditioned for 2 hours at 200°C temperature prior to use. Gas flow of nitrogen (Carrier gas), hydrogen and air was maintained at 40, 4 and 140 ml per minute. A 2 µl sample was injected in duplicate.

For carbofuran residue analysis in soil, the extraction of sample was done with acetone and clean up procedure was followed as described earlier for fruit sample. The operating condition of gas chromatography was maintained at, column 200°C, injector 240°C and detector 250°C. The column consisted of 100 cm long, 3 mm i.d. stainless steel tube with same type of packing mentioned earlier. The flow rate of different gases was also same as mentioned for fruit sample. The average recovery as per this procedure in fortified samples had been 87.00 per cent.

The carbofuran residues in fruits picked at different intervals varied from BDL to 1.13 ppm (Table 1). In case of treatment 0.5 kg a.i./ha., the carbofuran residue in

TABLE 1 : Carbofuran residues in fruits of *Trichosanthes dioica* Roxberg and its soil.

Sr. No.	Dose of Carbofuran 3 g per plant (a.i./ha)	Residue (ppm) (Av. of 2 replications)			
		15 DAT	Fruits 30 DAT	45 DAT	Soil 90 DAT
1	6 g/plant (0.5 kg a.i./ha)	0.38	BDL	BDL	0.88
2	12 g/plant (1.0 kg a.i./ha)	0.41	0.28	BDL	1.76
3	18 g/plant (1.5 kg a.i./ha)	1.13	0.42	BDL	1.89

BDL : Below detectable level (< 0.01 ppm), DAT : Days after treatment

fruits (0.38 ppm) remained above the tolerance level of 0.2 ppm prescribed by FAO/WHO⁴ for cauliflower up to 15 DAT. In case of treatments 1.0 and 1.5 kg a.i./ha the residues remained above 0.2 ppm up to 30 DAT. Further in all the three treatments, the residues were BDL at 45 DAT indicating its saftyeness to consumers from the view point of residual toxicity in fruits.

As regard the carbofuran residues in soil at 90 DAT, it was 0.88, 1.76 and 1.89 ppm at the dose 0.5, 1.0 and 1.5 kg a.i./ha respectively. Thus carbofuran is found to be persisting for more than 90 days in present study. Harris⁵ and Caro *et al.*⁶ have also reported longer persistence of carbofuran residue in field.

Thirumurthy *et al.*⁷ have observed none of the metabolites of carbofuran residues in okra fruits after 50 days while Agnihothrudu and Mithyantha⁸ have reported only 0.02 ppm residue in brinjal fruits after 52 days of carbofuran application in soil at the rate of 1.0 and 0.65 kg a.i./ha respectively.

Thus, it can be concluded that fruits obtained from pointed gourd plant treated with carbofuran at the rate of 0.5, 1.0 or 1.5 kg a.i./ha as a side dressing in soil would not pose any health hazard problem to consumers after 45 days of its application. Therefore, after planting the crop, all the three doses can be applied for plant protection

purpose and there would not be any residue problem of carbofuran in the fruits after 2 months of planting.

We are thankful to M/s Rallis (India) Ltd., Bangalore for providing Gas chromatograph facilities in residue analysis. Thanks are also due to Shri Ukabhai N. Patel for providing necessary facilities during field experiment.

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Demonstration of DNA with Feulgen reagents prepared with uric and folic acid and metabisulphite

The use of organic acids along with potassium metabisulphite for the preparation of Feulgen reagent has been reported¹. These reagents usually have less hydrogen ion concentration and consequently long shelf-life. This investigation was undertaken with a view to find out the ability of folic and uric acid, along with potassium metabisulphite, towards reducing aqueous solutions of basic fuchsin to colourless state and then to use these reagents for detecting the presence of DNA-aldehyde molecules in tissue sections subjected to Feulgen hydrolysis.

Feulgen reagents were prepared by dissolving 500 mg of basic fuchsin (E. Merck) to two separate lots of 100 ml of warm distilled water. To one of these were added 500 mg of uric acid and to the other lot the same amount of folic acid with acidic property. Both of these contained 1.0 g of potassium metabisulphite and mixed thoroughly. These were then left in the refrigerator for 30 min and afterwards shaken vigorously with 1.0 g activated charcoal and filtered. The filtrates were pale red in colour with pHs 5.2 and 4.9 respectively. After overnight storage at 5°C, the colour of the uric acid reagent became pale pink when seen in bulk while that of the folic acid reagent pale red. After a week's storage in the cold, both the reagents turned out to be almost colourless.

Tissues used were pieces of liver of a white rat fixed in 10% neutral formalin and Bouin's fixative. Paraffin sections (8 μ m) were used.

Staining was performed on deparaffinised sections which were hydrolysed in 6 N HCl at 30°C for 15 min in the case of formalin-fixed materials and 30 min in the case of Bouin-fixed materials. These sections were rinsed with water and then stained with the

dye-reagents at 5°C and 30°C and also under UV rays for 10 min in each case. Several drops of the individual reagent were spread over the sections in the form of a thin layer and then the slides were placed under different temperatures as well as under UV rays obtained from the inner discharge tube of a 125 watt mercury vapour lamp. Following staining, sections were treated with 0.05 N HCl for 1-2 min, rinsed with water, dried between folds of filter paper, treated with n-butanol for 1-2 min, cleared in xylene and mounted in DPX.

Microscopic examination of the sections of tissues fixed in formalin and Bouin's fixative revealed excellent nuclear colouration particularly when stained with any of the reagents at 30°C. Intensity of nuclear colouration obtained when stained under the influence of UV rays did not reveal augmentation of staining of the nuclei. The colouration obtained at 5°C and that obtained under UV rays was more or less the same. At 30°C, the intensity was definitely more than at 5°C. A thin layer of the reagent spread over the sections at 5°C revealed total lack of red colouration of the uric acid-reagent. On the contrary, at 30°C the reagent became slightly oxidised to a somewhat red colour. Under UV rays, the process of oxidation was hastened and the reagent became deep violet in colour. The same was true of the folic acid-reagent.

The shelf-life of both the reagents was at least six months. During this period there was no impairment in the intensity of nuclear colouration.

These results indicate that both formalin as well as Bouin-fixed tissues can be stained with the above reagents following Feulgen procedure.

It has been reported by the author² that there occurs augmentation of nuclear colouration when staining is performed with Schiff reagent under the influence of UV rays than in the control stained under the usual laboratory conditions. This phenomenon is not

evidenced in the case of the present dye-reagents. The reason for this may be that an increase in the intensity of nuclear colouration under UV rays is possible upto a certain pH of the dye-reagents. If the pH is too high, as in the present case, response may not be evident.

The slightly less intense nuclear colouration at 5°C over sections stained at 30°C is, however, a rule as pointed out in an earlier publication⁸.

It is interesting to note that the pH of both the reagents does not show stability after storage for some days in the cold. For example, the initial pHs of folic and uric acid reagents were 4.9 and 5.2 respectively, whereas after storage for 4 months these values were 3.1 in both cases. This phenomenon indicates molecular changes in the dye-reagents taking place slowly on being stored for some days. This drop in the pHs, however, does not affect the intensity of nuclear colouration.

Finally it can be said that uric and folic acids are both suitable substitutes for inorganic acids except nitric which cannot be used for the preparation of Feulgen reagent.

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Received : 30 December, 1986.

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A hematological study of Indian cricket frog *Rana limnocharis* Bois in Weigmann

Indian cricket frog *Rana limnocharis* are small sized frog with an average snout-vent length of 29 mm. Hematology of this frog is reported for the first time in this study which is available in plenty during the mon-

soons. Observations were made on these frogs available in Bhubaneswar located 25 m above sea for a period of two years (1979 and 1980). Blood samples collected in heparinized capillary tubes were centrifuged and hematocrit percent (packed cell volume) was determined by a hematocrit measuring scale. Total erythrocyte and leucocyte counts were made according to the method described by Dacie and Lewis¹ by a hemocytometer, using amphibian saline (0.65%) with gentian violet as RBC diluting fluid and 0.1 N HCl with neutral red (1% in 0.1 N HCl) as WBC diluting fluid. Hemoglobin concentration was determined in a hemometer. Leucocyte differential count was made by staining a thin smear with Leishman's stain. The pH of blood was determined with pH paper with fractional range between 6.0 to 8.0 (Merck, Germany).

Sexual dimorphism in this frog was reported for the first time in some hematological parameters (Table 1). The RBC total count and hemoglobin gm were significantly ($p < 0.05$) higher in males than females whereas the WBC total count was significantly higher in females than males. There was no significant difference in other hematological parameters of males and females.

The erythrocytes are elliptical in shape with centrally located nucleus. The average size of long and short axes of erythrocytes were 15.09 μ and 8.55 μ respectively. The spindle shaped thrombocytes had an average long and short axes of 12.1 μ and 3.66 μ respectively. The following five types of leucocytes with corresponding mean diameter sizes, given in the parenthesis were noted in *Rana limnocharis* : Large lymphocyte (9.77 μ), Small lymphocyte (5.77 μ), Monocyte (9.55 μ), Neutrophil (8.77 μ), Eosinophil (7.77 μ) and Basophil (8.72 μ).

A survey of literature shows that reports on the hematology of Indian amphibians is very scanty²⁻⁵. The blood cell types of this frog are like that of *Uperodon systoma*⁶. Hematology of amphibians varies with sex, season and physiological condition of the

TABLE 1 : Hematological averages for *Rana limnocharis* (10 individuals in each sex)

Blood value and cell life	Sex	Mean (X)	S. E. of (X)
Erythrocytes in million (per mm ³)	♂	1.59	0.13
	♀	1.13	0.08
Leucocytes (per mm ³)	♂	12826	816.39
	♀	14810	995.14
Hemoglobin (in gm/100 ml)	♂	13.02	0.56
	♀	10.5	0.33
Hematocrit (in % cell)	♂	29.9	2.49
	♀	33.5	3.27
pH	♂	7.2	0.01
	♀	7.3	0.04
Lymphocyte (%)	♂	65.4	1.9
	♀	70.2	1.47
Monocyte (%)	♂	18.8	1.52
	♀	14.9	1.32
Neutrophil (%)	♂	13.8	1.34
	♀	12.9	1.25
Eosinophil (%)	♂	1.6	0.37
	♀	1.7	0.49
Basophil (%)	♂	0.4	0.16
	♀	0.3	0.15

animal⁵. The results depicted in this study are basic in nature and further studies are needed to be done.

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On vector of phyllody disease in Kashmir

Cruciferous crops are known to be affected by many insect pests and diseases. Among the diseases phyllody is the limiting factor in seed production of cruciferous crops. In Kashmir 50-60 per cent cabbage plants have been reported infected with phyllody disease¹. Phyllody disease in *Sesamum* have been classified as mycoplasma disease² and intensity of this disease in *Brassica* spp is affected by the activity of insect vector *Orosius albicinctus*³. The present study was undertaken to ascertain the presence of *O. albicinctus* under Kashmir conditions.

Survey undertaken showed that *O. albicinctus* is not associated with the cruciferous crops in Kashmir. However, among other insect pests large populations of a hopper species indentified as *Macrostelus quadripunctulatus* (Kirschb) was recorded. The possibility of this Cicadellid as a vector of phyllody disease was studied. Crop selected for this purpose was turnip, purple top variety. Seeds of turnip were sown in sub-plots on 9th September, each sub-plot

from caged plants in which hoppers were released as compared to Zero per cent in case of caged plants without hoppers. Plants left uncaged gave rise to 50 per cent phyllody infested plants. This shows that *M. quadripunctulatus* is associated with transmission of phyllody in turnip plants in Kashmir. There is no literature available either to show association of *M. quadripunctulatus* with cruciferous crops or transmission of casual agent of phyllody disease by this hopper

TABLE 1 : Per cent phyllodid turnip plants in various treatments

Treatments	% phyllodid plants					Mean
	I	II	Replications III	IV	V	Total
Caged plants without hoppers	30 (33.21)	30 (33.21)	40 (39.23)	40 (39.23)	60 (50.77)	200 (39.23)
Caged plants without hoppers	0	0	0	0	0	0
Uncaged plants	40 (39.23)	50 (45.00)	50 (45.00)	60 (50.77)	50 (45.00)	250 (45.00)

Figures in parenthesis are the $\sqrt{n+1}$ transformations ; S.E. = 2.813 ; C.D. = 6.486

measuring 2 x 2 m. Five rows of turnip seed 8 and 45 cm distance between seed to seed and row to row respectively, were sown in each sub-plot. Six sub-plots were caged with muslin cloth right from the date of sowing till harvesting of roots and again from transplantation of roots till seed. In 3 caged sub-plots 200 *M. quadripunctulatus* each collected from field were released at three leaf stage. In the remaining three caged sub-plots no insect was released. These plots were frequently sprayed with 0.2% phosphamidon to ward off any possible pest infestation. Three sub-plots were left uncaged and no insecticide was sprayed to these plots. In each sub-plot 13 plants were maintained. The experiment was replicated five times in a randomized block design. All the sub-plots received uniform agronomical practices. At the time of seed set number of phyllody infested plant from each sub-plot were recorded. From this number per cent phyllodid plants were worked out in each case.

The results in table 1, revealed that 40 per cent phyllodid plants were recorded

species in these crops, from India or abroad. However, this hopper species is reported as a pest on carrot esters and lupinus from Poland. This show that it is first record of *M. quadripunctulatus* as vector for transmission of casual agent of phyllody disease in turnips. However, detailed studies shall have to be carried out in future.

The author is highly thankful to C.I E., London for having identified the hopper species.

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Revised : 14 April, 1987.

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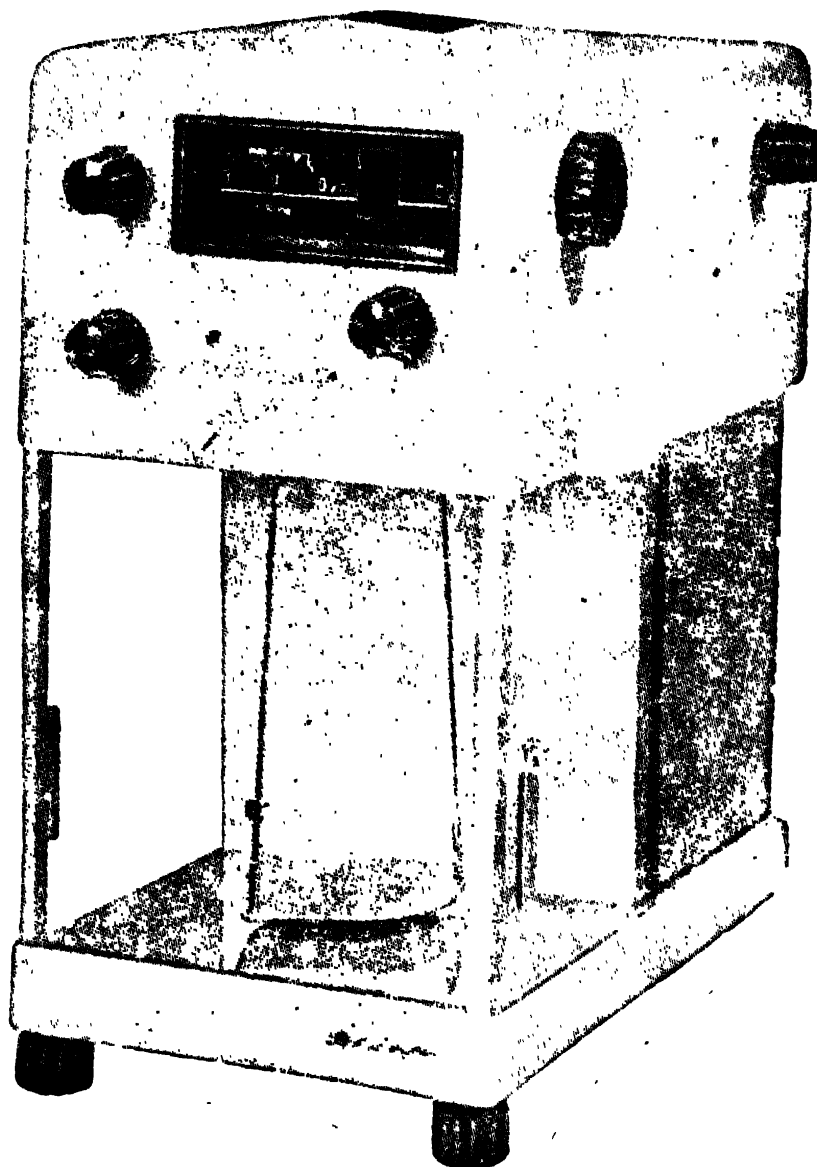
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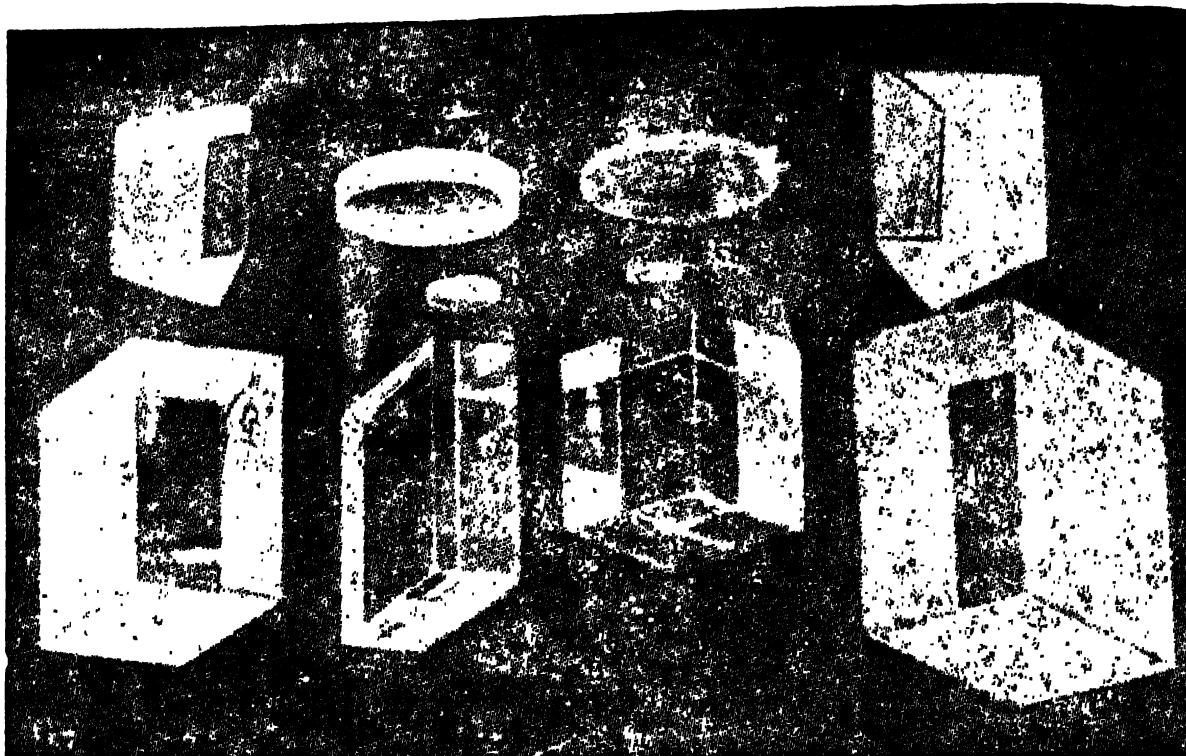
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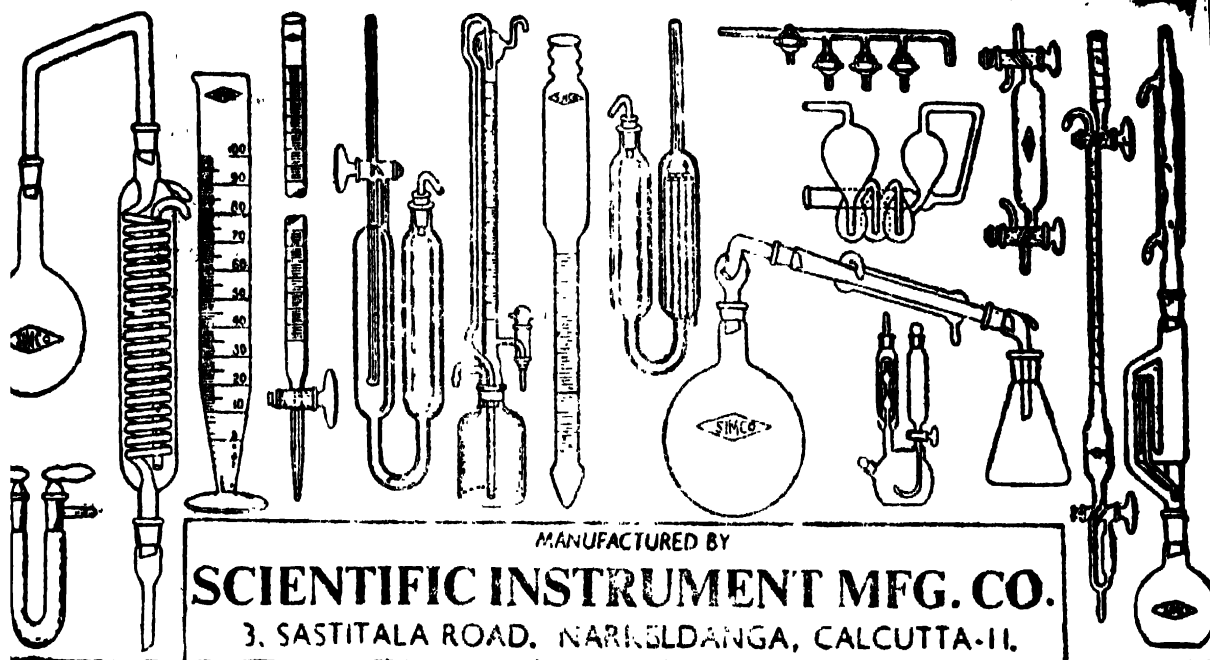
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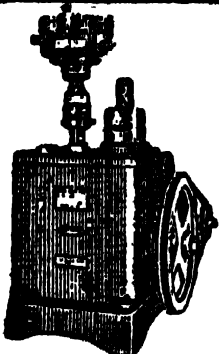

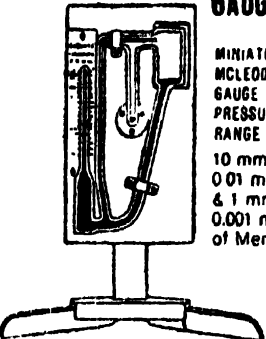

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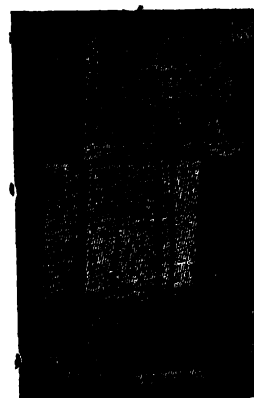
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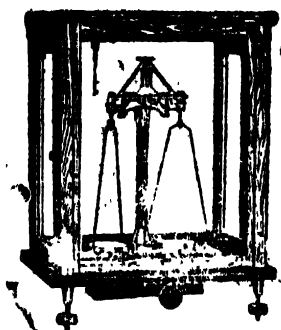


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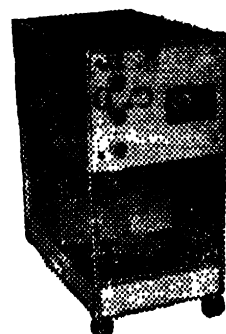
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MEGHNAD SAHA AND THE THEORY OF THERMAL IONISATION

TWO original contributions of Meghnad Saha entitled 'Ionisation in the Solar Chromosphere' and 'On a Physical Theory of Stellar Spectra' published in the *Phil. Mag.* (1920) and the *Proc. Roy. Soc. Lond.* (1921) respectively brought him to the lime-light in the world of astrophysics in no time. Popularly known as the Saha's equation on the theory of thermal ionisation, Saha's first paper revolutionised the existing astrophysical ideas and concepts. Before this discovery a large number of data on stellar spectra collected by Lockyer, Sechi and others was being classified by trial and no simple theory was available to explain these data on a physical basis.

The fact that the high temperature inside a star deprives most of the electrons of the atoms was envisaged by Eddington in his theory of internal constitution of stars but the method how the atoms are ionised was suggested by Eggert on the basis of law of reaction isochore using the hypothetical values of ionisation energies of different elements. Saha had the credit to use the values of ionisation potentials available from experiments. This added a new dimension to a quantitative analysis of the solar chromosphere and the discovery could explain the disappearance of arc line from the higher layers and the intensification of spark line in the solar atmosphere due to reduced pressure.

Saha communicated the paper on Ionisation in the solar chromosphere along with a paper 'On the Harvard classification of stellar spectra' to the Philosophical Magazine. When working in the laboratory of Fowler, Saha was convinced of the fact that besides the

Harvard Scientists, Lockyer and his pupils had a large contribution to the stellar classification. With all these papers of Lockyer's group and views from Fowler, Saha withdrew the paper 'On the Harvard classification of stellar spectra' and rewrote it with the new available ideas which was communicated by Fowler to the Royal Society as a new paper entitled "On a physical theory of stellar spectra".

In an article in this issue the importance of Saha's theory in Astrophysics is extensively evaluated by the author. We may mention here that Lockyer conducted a number of experiments in his laboratory to explain the stellar interior at high temperature. Since, the physical basis of the results remained unexplained for many years, Lockyer in his life time did not receive recognition, as it ought to be, in the world of astrophysics. Saha's theory could bring Lockyer's experimental works to a lime-light and this was very gratefully acknowledge by Lady Lockyer in a later period.

What impact the Saha's equation had in the world of physical science is known from how extensively his work were quoted by other scientists in their related works.

In the messages of appreciation on the Sixtieth Birthday Celebration of Meghnad Saha, a large number of scientists from all over the world congratulated Saha for his outstanding contributions.

On this occasion, A. H. Compton from the Washington University writes to Professor Saha congratulating him for his outstanding contribution in thermodynamics. He also

refers in his letter that at one time he had the honour to nominate Prof. M. N. Saha for the Nobel Prize for his work in this area. Otto Struve from the University of California writes "Saha's work has been a source of constant inspiration to virtually every physicist during the present generation. My own early studies in stellar spectroscopy received an impetus from his work, and I believe that I have never written a scientific article in which I have not in one form or another made use of his theory of ionisation". Menzel from the Harvard College observatory writes "The famous theorem that bears his name has been the key that has unlocked the secret of stellar atmospheres", P. M. S. Blackett from Imperial College writes "His famous early work.....assures to Prof. Saha a worthy place in the history of physical sciences".

Similar messages came from K. T. Compton, E. Fermi, E. O. Lawrence, I. S. Bowen, H. Shapeley, H. C. Urey, J. Franck, Vallarta, H. N. Russel, W. S. Adams, E. Appleton, A. V. Hill, J. D. Cockroft, J. B. S. Haldane, Max Born, H. Spencer Jones, R. Robinson, J. Needham, F. Joliot Curie, Heisenberg, Otto Hahn, W. Grotrian, Bothe, R. Oppenheimer and many others.

Though Professor M. N. Saha was later on interested in nuclear and biophysics, his first love was astrophysics. In 1938 when A. S. Eddington came to India to attend the Science Congress at Calcutta, he visited Allahabad on invitation from M. N. Saha, who was then the professor in the Allahabad University. On behalf of the citizens of Allahabad, the Allahabad municipality felicitated Eddington at that time in a large gathering of citizens of Allahabad. Prof. Eddington in reply to the felicitation, while addressing the meeting, commented that India now requires an institute wholly for astrophysics, since the country has scientists like M. N. Saha to lead such research.

Saha had a life long dream for an astrophysical research institute in India. But it could not be fulfilled in his life time. His interest to ionospheric research or many

contributions towards astrophysics show his profound ability in the subject. However, it is gratifying that long after the death of Prof. Saha an institute of astrophysics, a kind which Saha dreamt of, has been established in Bangalore. At the same time it also reminds us that M. N. Saha as a pioneer astrophysicist of the country is not duly recognised by our country. One way of such recognition would be to name the above institute after him on the eve of the ensuing birth centenary of M. N. Saha falling in the year 1993. It may be cited here that on September 22, 1956 in a meeting of friends, admirers and colleagues of Late Prof. M. N. Saha, presided-over by Shri C. C. Biswas, the then Union Law Minister, it was decided to establish a radio-astronomical Institute in memory of Prof. M. N. Saha to study stellar phenomena through the observation of radio waves for which a sum of Rs. 5 lakhs had to be raised from the public. The proposal did never materialise. In 1954, Prof. Saha while visiting the Radio-telescope at Jodell Bank was impressed and wanted to see such a laboratory flourish in India. Actually Prof. Saha began to plan the project with the details from the Dutch Research Group under Van der Hulst, when came his sudden death.

In this context, it may be mentioned that apart from astrophysics and thermodynamics Saha's equation has extensive applications in plasma physics, magnetohydrodynamics, surface ionisation and cavity ionisation phenomena. The latter two phenomena are important for ionosphere technology, used in various nuclear experiments.

Collected scientific works of M. N. Saha have been published by the Council of Scientific and Industrial Research, India, which show the interests and talents of Saha in many branches of physical science. But his pioneering contributions in astrophysics in the pre-Independence period of the country are unique and will be considered as a milestone in the long way in the history of science. □

S. B. Karmahapatro

SAHA EQUATION : A GIANT STEP IN ASTROPHYSICS

J. C. BHATTACHARYYA*

ASTROPHYSICS is a relatively modern branch of science based on the foundations which are as old as human civilization. The innate curiosity which had egged on human mind to search and ponder over the mysteries of the universe had blossomed into the ancient science of astronomy. In the primitive days, it had consisted almost entirely of familiarity with the heavens—the constellations and movements of bright celestial bodies among them. Remarkable regularities in those movements were perceived, and early efforts in understanding the structure of the visible universe of those days can be seen in old astronomical records.

Linking up of the astronomical observations with laws of physics began early in the seventeenth century. Although, Galileo with his telescope played a pivotal role at this juncture, the idea was firmly established a few years earlier by another astronomer, Johannes Kepler, with the formulation of his precise laws of planetary orbits. It is also true that several scientists of bygone era had also left behind signs of their attempts to link the celestial phenomena with our earthly experiences. Examples that readily come to our mind are those of the Greek astronomers Hipparchus and Erathosthenis of pre-Christian era, who sought out reasons for observed features in celestial phenomena. The fifth century Indian scientist Aryabhata came very close to the truth about earth's gravitational attraction ; in one of his sloka's in *Aryabhatiya*, in trying to explain the apparent diurnal tracks of celestial bodies as observed from different places on the earth, he describes everything on earth's surface being like petals of a Kadamba flower—a superb example of a logical solution which matches

actual observations. The idea had sounded preposterous to his contemporaries.

It was Isacc Newton who firmly established the universality of physical laws ; he showed that the same fundamental principles can explain both planetary motions as well as the laws of falling bodies in their finest details. In my opinion the subject of Astrophysics should have been reckoned to start from that date. The prediction of Edmund Halley about his famous comet or that of Laverrier and Adams about the eighth planet Neptune have all the elements of application of physical laws to understand nature. But in the annals of scientific literature, they are all described under the subject of astronomy.

Traditionally the birth of the new subject "Astrophysics" is considered from the event of successful application of the new method in Physics, Spectroscopy, to astronomical discoveries. Only a few years before that time, many scientists used to boldly state that whatever progress man might have made, the secret of the chemical composition of distant bodies will never be known. It was this belief which was shattered by the new application of a powerful tool in Physics.

The first successful test was enacted on the Indian soil ; the date was 18th of August 1868, the occasion—a total solar eclipse whose track crossed over the Indian peninsula. Several expeditions from far away countries came. Near Guntur, the British team was located ; the celebrated French astronomer Janssen was also there in a nearby location. Just before and after the totality, during the flash phase of the eclipse, both teams noticed an emission line in the yellow region of the spectra. Careful measurements

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proved that its wavelength is slightly displaced from the Fraunhofer D lines of sodium. Sir Norman Lockyer in England, after careful examination of data speculated the existence of a new element on the sun. After the greek name of the sun, "helios", the new element was named "helium". The scientists had to wait for 27 years for confirmation before Ramsay discovered the element in his laboratory in 1895.

Many bits of new information started coming in by applications of the new method. Within a couple of years Young observed the flash spectra—the several of Fraunhofer lines during a total solar eclipse. The information suggested peculiarities in temperature profiles in the solar atmosphere. Gradually the method of photography came in observational practice making more detailed and definite observations. Astrophysics really provided means of peeping into the secrets of celestial bodies.

Important landmarks in astronomical spectroscopy on which the foundation of astrophysics rests, can be briefly described thus. Besides discovery of Helium, in 1868 English astronomer Huggins successfully measured small doppler shifts in the positions of Balmer lines of hydrogen in the spectrum of Sirius : The first radial velocity observations. In 1872, Henry Draper took the first photograph of stellar spectra in the light of Vega. Pickering discovered the first spectroscopic binary, Mizar from periodic doubling of its spectral lines in 1889. 1891 witnessed the invention of spectroheliograph, independently by Hale in U. S. A. and Deslandres in France. In 1908 Hale found magnetic fields on the sun from Zeeman splitting of lines in solar spectra. First Hertzsprung—Russell diagram was drawn up in 1911, starting the fascinating subject of stellar evolution. In 1915 Adams found peculiarities in the spectra of Sirius B opening up another dimension in astrophysics through studies of white dwarfs. In 1920 Slipher announced his results on the redshifts of external galaxies, which later provided Hubble and Eddington with basic materials

on their theories about the expanding universe.

In the same year once more in India, a giant step in our knowledge in Astrophysics was achieved. There were no special events like the one which ushered in the new subject half-a-century ago, nor a galaxy of world-renowned scientists congregating to solve a nagging problem. It was a lone young scientist, who did not even have an opportunity of visiting a modern observatory, came upon a solution which was being sought by scientists all over the world. The enigma was a series of anomalies in the stellar spectra which did not appear to fit in any pattern. The solution : Unveiling of another basic property of matter—ionization. The scientist : Meghnad Saha, a newly appointed young lecturer in the Department of Physics, University of Calcutta.

In order to understand Saha's momentous contribution to Astrophysics, let us go back to the early ages of Spectroscopy. The spectral lines were known to be formed due to emission from or absorption by matter ; it was a Swiss school teacher Balmer who first noticed a remarkable order in the wavelengths of the series of lines due to hydrogen. Other series due to many known substances were subsequently recognized. After Planck's formulation of quantum hypothesis, Bohr proposed his famous model of hydrogen atom, which beautifully explained the order in the spectral line series of hydrogen. Bohr's paper was not accessible to Indian scientists during world war days. Prof. D. M. Bose of Calcutta University returned from Germany after the war and he brought a copy of Bohr's paper. Saha was thrilled by the elegance of the approach.

It was known by that time that the same substance emits different sets of lines depending on the mode of excitation. Spectral line series obtained from spark are different from that when continuous arcing generates the light. It was also recognized that effect is due to temperature, because of the fact that at higher temperatures, the emitting and absor-

bing atoms are likely to lose outer shell electrons and get ionized. The lines emitted by ionized atoms are completely different from natural ones.

In the spectra of sun and stars collected by various observatories hundreds of lines had been identified with several elements in their ionized and neutral states, but the strengths of these lines posed a puzzle. The strongest line in the solar spectrum is not the red line of hydrogen alpha, but the violet line due to ionized calcium which had been marked as K by Fraunhofer. Why should the K-line be stronger than H-alpha which is generated by the most abundant element hydrogen? Also, big and small stars had been analysed spectroscopically; they were known to possess envelopes with varying temperatures, but the strengths of different lines do not follow any systematic pattern. Strong Balmer lines are seen in A-type stars; for cooler stars their strength systematically decreases; this behaviour is expected. But they also decrease in strength as one moves to hotter stars. Speculations about different compositions or progressive transmutation of elements in the stars were rife, but those solutions appeared arbitrary; a logical answer eluded the scientific community.

Saha appeared on the scene at this juncture. How he solved the puzzle and laid the foundation of future course of astrophysics can be described in his own words:

"It was while pondering over the problems of astrophysics, and teaching thermodynamics and spectroscopy to the M.Sc. Classes that the theory of thermal ionization took a definite shape in my mind in 1919. I came across a paper by J. Eggert in the *Physikalische Zeitschrift* (p. 573) Dec. 1919, "Über den Dissoziationszustand der Fixsterngase" in which he applied Nernst's Heat Theorem to explain the high ionization in stars due to high temperatures, postulated by Eddington in course of his studies on stellar structures. Eggert, who was a pupil of Nernst and was at the time his assistant, had given a formula for thermal ionization, but it is rather strange

that he missed the significance of ionization potential of atoms, importance of which was apparent from the theoretical work of Bohr, and practical work of Franck and Hertz which was attracting a good deal of attention in those days... Eggert used Sackur's formula of the chemical constant for calculating that of the electron, but in trying to account for multiple ionization of iron atoms in the interior of stars on this basis, he used very artificial values of ionization potential.

While reading Eggert's paper I saw at once the importance of introducing the value of ionization potential in the formula of Eggert, for calculating accurately the ionization, single or multiple, of any particular element under any combination of temperature and pressure.

I thus arrived at the formula which now goes by my name. Owing to my previous acquaintance with chromospheric and stellar problems. I could at once see its application..."

Saha prepared four papers on this idea. In the first one where he tackled the problem of anomalous strength of Ca^+ K lines in chromospheric spectra he deduced the famous equation. He clearly proved that although Calcium is a minor constituent of solar material, under the thermodynamic conditions existing in the thin chromosphere, this particular line will appear almost totally blanketing. One long standing enigma in astrophysics was solved.

A clear picture of the puzzle of stellar spectra had also been formed in Saha's mind. He wrote a paper on this topic and submitted the same in the Griffith Memorial Essay Competition of Calcutta University and won the prize. After revising the paper a couple of times it was finally published in the Proceedings of the Royal Society under the title "On a physical theory of stellar spectra". The title was suggested by Prof. Fowler whose laboratory Saha was visiting at that time.

The paper beautifully explained all the observed features in stellar spectra. The

reduced strength of Balmer lines in hot stars was simple due to the fact that the hotter the star, the less is the number of unionized hydrogen atoms left in its atmosphere to participate in the absorption process. The appearance of lines due to ionized atoms in high temperature stars and molecular lines in cooler stars are simple manifestation of a thermodynamic process. The entire spectral sequence is due to temperature and to a less extent, to pressure, the physical properties of matter supply the remaining clue to the solution of this long standing puzzle.

The enormity of impact of Saha's theory on astrophysics is difficult to comprehend. I would prefer to quote Rosseland in the introduction to his book "Theoretical Astrophysics". Who have neatly summarised this aspect. Rosseland writes ;

"Although Bohr must thus be considered the pioneer in the field, it was the Indian Physicist Meghnad Saha who (1920) attempted to develop a consistent theory of spectral sequence of the stars from the point of view of atomic theory.

Saha's work is in fact the theoretical formulation of Lockyer's view along modern lines, and from that time the idea that the

spectral sequence indicates a progressive transmutation of the elements has been definitely abandoned. From that time dates the hope that a thorough analysis of stellar spectra will afford complete information about the state of stellar atmospheres, not only as regards the chemical composition but also as regards the temperature and various divisions from a state of thermal equilibrium, the density distribution of the various elements, the value of gravity in the atmosphere and its state of motion. The impetus given to astrophysics by Saha's work can hardly be overestimated as nearly all later progress in the field has been influenced by it and much of the subsequent work has the character of refinements of Saha's ideas".

Such was the importance of "Saha Equation of thermal ionization" in understanding some of the enigmas of nature. Extension of his ideas to modern branches in astrophysics has helped clearing doubts about several physical processes. It is for these reasons Sir Arthur Eddington has included Saha's theory of stellar spectra as one of the ten most important events in the history of Astronomy, since Galileo introduced telescopes in astronomical studies. □

UTILITARIAN ASPECTS OF AN AGROMETEOROLOGICAL OBSERVATORY TO THE FARMERS

V. S. RAMACHANDRAN AND C. J. ITNAL*

THIS article gives a brief account in nontechnical language how best the weather observations are applicable under prevailing farmer's field conditions to ameliorate the crop damage risks such as crop insurance. A systematically organised agrometeorological observatory can provide weather information useful for growing the crops nearby. It is regarded as a reflective

mirror of day-to-day life activity of the farmers and considered to be a guide to the farmer's biological clock. The weather to a farmer is a precious resource and the ignorance of it often results in empty stomachs. The degree of promptness of implementation of certain agricultural operations over the farmer's field are controlled and governed by adverse

*Dryland Agriculture Project, G. K. V. K.

weather conditions. Just as the weather observations provide information to a scientist, the farmer's own dwelling place can teach him the simple weather lore so as to protect himself from weather hazards and thereby increasing the national economy by enhancing the crop yield. A dryland farmer always come across bitter uncertainties in agriculture, since the nature itself is such an unpredictable hazardous resource.

Even-though the scientific methods of investigating the weather is beyond reach from the farmer's point of view, the weather broadcasting can benefit to suit his needs since many rainfed agricultural operations revolve around the accuracy of weather forecasting, particularly rainfall. The easily assessable weather parameters like rainfall and temperature have appreciable influence on a layman's biological and socio economic environment. Based on this assumption, the authors have enumerated an agro-ecological index (the ratio of annual rainfall index to the annual open water evaporation) for Bangalore for a period of 20 years from 1961 to 1980 and shown in the Table 1. The values of the index indicate that no two years are quite agro-ecologically similar. The smaller the index, the more drier is the climate resulting in discomfort, while large values indicate progressively humidified and comfortable conditions. The agro-ecological index of a region will provide an understanding of the existing ecosystems in agriculture through weather inputs like rainfall and evaporation. The weather observation will provide the farmer a specific clue in farming the weather. Though the farmers have a clear cut knowledge everyday about weather bulletins either through television and radio or newspapers, many of them avoid to implement just because of illitracy and negligence.

The farmers can increase the yield when once they are more and more concerned with weather forecasts like what has already

TABLE 1: Agro-ecological index at Bangalore

Year	Annual rainfall index	Annual Evaporation	Agro-ecological index
1961	52033	1679	31
1962	67373	1606	42
1963	57718	1830	32
1964	67779	1898	36
1965	23800	1971	12
1966	59228	1825	33
1967	32242	1940	17
1968	41950	1898	22
1969	78413	1898	41
1970	63507	1825	35
1971	46888	1793	26
1972	71388	1716	42
1973	58062	1716	34
1974	60134	1752	34
1975	67763	1537	44
1976	38657	1679	23
1977	72463	1533	47
1978	44346	1825	24
1979	85938	1581	54
1980	35407	1277	28

happened yesterday, is happening at present today and bound to be happen tomorrow. The farmer shall keep in touch with the day-to-day weather summary (just as the pilot before take-off and landing) in order to commence the tomorrow's agricultural operation so as to achieve better yields. The majority of the dryland farmers are cautious mainly of aberrations in rainfall and temperature in their normal routine of domestic life at home and in the field. However, the other elements like soil condition, light, humidity, evaporation, wind and sky conditions are often decessive factors causing panic and havoc in their daily activity of life. The daily weather observations will provide an idea about the physiological human thermal comfort for the modern society and the agricultural water potentiality to a farmer. Information on weather is often required in planning the decission makings with respect to man-power needs in the mass-scale agricultural operations which enhances the farmer's yield and national economy. □

Notes and news

New advances in thermal imaging

Researchers at a British hospital specialising in the whole range of rheumatic diseases are exploring the potential of thermal imaging (analysing the heat distribution in the human body) in an effort to increase their knowledge of how rheumatic diseases start, how best they can be treated and what equipment is best suited for the job.

This patient's pressure sore—one of the outcomes of rheumatic disease caused by patients spending many hours immobilised in a wheelchair or a bed—is being studied using new experimental equipment, including a portable camera that allows a doctor to move from conventional filming to thermal imaging and combine both techniques to generate a complete picture of the progress of treatment. The research programme also includes work on a new high-resolution camera that can picture large areas of the body without loss of detail. The results are exceptionally high-quality thermograms, especially in close-up.

The thermal images are recorded using analogue 2.5 cm video tape. Calibrated images can be stored and retrieved without loss of information, and single frames can easily be taken for quantitative analysis □

Spectrum

India's emphasis on oil palm cultivation

The Government of India has recently undertaken some measures to encourage cultivation of oil palm with a view to overcoming edible oil crisis in the nation. At present, Kerala and Andaman islands are found best suited.

In the first, the government has formed a panel of specialists to locate regions where it can be grown. Secondly, it has taken a deci-

sion to set up two modern palm-oil extraction units so as to increase processing facilities of fruits of oil palm crop. Thirdly, it has decided also to provide facilities for extraction of oil from the kernel.

These considerations of the government are based on some unique properties of oil palm; at first, oil palm is the highest-yielding crop. On the average, it yields some tonnes of oil varying from 4 to 12 tonnes per hectare while other seed crops such as groundnut, soybean, sunflower, safflower do not yield usually more than one tonne per hectare.

The second advantage with palm oil is that it contains very high amounts of vitamin A. Night blindness being a major problem in India, it is hoped that palm oil usage may go in a long way to prevent night blindness caused by the deficiency of vitamin A.

In addition, palm oil contains vitamin E. Combination of two vitamins in edible oils is not very much common. Palm oil, on fractionation, gives off palm olein and palm stearin—the two potential oils for the manufacture of vanaspati. Moreover, palm olein itself is a good vegetable oil for cooking purposes.

Palm kernel oil is widely used in the manufacture of detergents as it contains very high amounts of lauric acid. □

P. C. Bhattacharyya

Ocean Pollution and Biosphere

The computer centre of the USSR Academy of Sciences has started an experiment to estimate how the pollution levels in the World Ocean influence the biosphere.

According to Nikita Moiseyev, Deputy Director of the Centre, even a molecule-thin oil film on the water surface interferes considerably with energy exchanges between the ocean and the atmosphere, prevents evaporation and, consequently, affects climate and distribution of precipitation and moisture. A computer mathematical model will help

predict the remote ecological consequences of ocean pollution.

Specialists from the UDA Institute of Oil in Bashkiria, have proposed the use of airships on electric cableways for carrying cargoes to hard-of-access oil and gas fields in Western Siberia. A pilot airship has been built, which can carry passengers, or up to 30 tons of cargo, at a speed of up to 80 km/hr. One kilometre of such cableway will be ten times cheaper than a hard-surface road. Airships can be used to carry timber and ores from remote parts and across mountain ridges. □

Soviet Features

Bacteria Feeding on Brown Coal Developed

Bacteria that feed on brown coal have been evolved by scientists from the institute studying the problems of the Kansk-Achinsky coal basin in the Soviet Republic of Kazakhstan. The bacteria will turn into fertile soil external spoil heaps which contain coal not suitable for burning or processing. As per the estimates of specialists, there are some 700 million tons of it there.

According to Professor Vladimir Butkin, Director of the Institute scientists from many countries are studying the problem of turning low-quality coal into fertile lands. Most of them concentrate on the chemical processing of coal and grow bacteria in water solutions of the coal. This institute evolved a family of bacteria processing coal waste. □

Soviet Features

Earlier Detection of Bent Spines

A British woman's suffering with a spinal deformity has prompted her husband to design a device that could have detected her condition early enough to have made treatment possible. It is now to be used in schools and clinics all over the world for the early diagnosis of scoliosis (spinal curvature disease) and other spinal disorders.

Mr. Robert McDonough, a student at Trent Polytechnic in Nottingham, designed and made his prototype device during work on a final-year project as part of a craft and design course. The attraction of the device is that it is simple, portable and could be bought for use by clinics for less than £ 50 and used at any school having a micro-computer available.

In scoliosis (from the Greek meaning curvature) the spine becomes curved to one side and at the same time the vertebrae become partially rotated around their axes. Because the ribs are attached to the spine, the rotation often causes the ribs to project backwards on one side of the body, and they in turn may make the shoulder blade become more prominent on the affected side. When scoliosis affects the lower spine, the ribs are unaffected, but one hip often sticks out more than the other.

Normal children often have a spinal curvature to one side or the other and if this changes into scoliosis the condition is often not detected until it is too late for treatment to strengthen the spine without an operation. Early detection, however, often allows the condition to be treated by wearing a brace and by traction in bed at night.

Ideally, say experts, scoliosis should be screened for by the examination of every schoolchild at yearly intervals. But the equipment needed to diagnose scoliosis at present costs thousands of pounds—beyond the reach of some health authorities for use in out-patient clinics or mobile clinics visiting schools.

Mr. McDonough's device for early diagnosis consists of three metal rods joined together end to end to form a single rod with two joints. At the hinges of the joints are potentiometers, instruments which change their resistance to electrical currents. One end of the joined rod is fixed to the bottom of the spine being examined, and the other end is applied successively to the protrusions of the spinal vertebrae, starting at the tip of the spine and working down.

This means that the hinges carrying the potentiometers are rotated to differing extents as each new point is touched by the top end of the rod. The change in currents flowing through the two potentiometers is picked up and fed to a computer which analyses them and uses the data to produce a graphic picture of the spine on a TV screen. This can be scanned by doctors, who can also compare it at each successive examination to previous data on the same child stored in the computer's records.

Mr. McDonough developed his device with the aid of two other researchers, Professor Burwell and Mr. Kim Burton. □

Spectrum

Hot on the Trail of the Ceramic Engine

Early tests with experimental truck engines fitted with ceramic-coated pistons and valves, and insulated to reduce heat losses, have already shown that they are capable of increased efficiency through an ability to operate at high temperature.

Motor industry experts believe the use of ceramic components in engines of the future will open the door to more power and efficiency because metal components can withstand only limited high temperature before distorting or failing.

The problem facing engine designers in using ceramics is that while the material can withstand the higher temperatures being sought, it is brittle by nature and in most present-day applications is only required to have a limited life. Work by the British Ceramic Research company, however, has shown that engineers and scientists are well on the way to solving this problem. Engines fitted with ceramic piston crowns have been tested for many hours without failure of the ceramic. A spokesman said full-scale trials with a diesel engine fitted with ceramic piston crowns had produced "encouraging results".

A vehicle diesel engine normally operates

at temperatures of up to 900°C but this can be increased to 1300° with the use of ceramics. It is just this sort of performance, combined with reliable long life, that is being sought under a British Government project known as CARE (ceramic applications in reciprocating engines) that is being headed by Leyland Trucks.

Leyland was at the 1986 International Motor Show in Birmingham (English Midlands) with the first truck in Europe to be shown with a high efficiency, insulated engine that has special cooling and ceramic-coated components.

A Leyland spokesman said at the Show: "The engine is an experimental one designed to power trucks of the future and to provide improved fuel consumption, lower noise and better cold starting."

The precision-cooled cylinder head of the experimental engine has directed water cooling passages as opposed to the conventional water jacket, and an uncooled exhaust port. The smaller cooling systems save weight and reduce the size of the unit, which in turn will allow designers to improve the aerodynamics of the vehicle.

The ability of the engine to run at higher temperature means the smaller cooling fan needed will cut fan noise levels while the insulation introduced to contain the engine heat will also improve cold starting.

The research project has a further three years to run, during which Leyland says it expects to increase greatly both its practical and theoretical knowledge of the potential of the ceramic engine. □

John F. Webb
Spectrum

In Search of Baldness Cure

Scientists at Dundee University's biological sciences department in Scotland have been given £ 1 million financial backing by the U.S. pharmaceutical giant Proctor and Gamble to study hair growth in a new

attempt to produce a cure for baldness and other scalp disorders.

Led by Dr. Roy Oliver and Dr. Colin Jahoda, the team of 14 researchers will study the cells and normal control mechanisms involved in hair growth. Particular attention will focus on dermal papilla and the follicle, the sac of skin which houses the hair's root.

The team will investigate anomalies such as why balding men still need to shave. They will also try to find a natural means of promoting hair growth.

Dr. Oliver, who has much experience in his field, is cautious of predicting a total cure. But he said that their research could provide fundamental advances in the study of skin and cell formation and make a significant contribution to the understanding of hair growth and loss. □

Spectrum

INSA Medal for Young Scientists—1988

Instituted by the Indian National Science Academy in 1974 the medal is awarded annually in recognition of outstanding work of scientists below the age of 32 (as reckoned

on 31st December preceding the year of award). Only those *born on or after January 1, 1956* are eligible for consideration in 1988. The work done in India by the nominee will be taken into consideration for the award.

The awardee is presented a *medal* and a *cash award of Rs. 5,000/-*. In addition, the recipient is considered for a research grant by the Academy *not exceeding Rs. 20,000/- per year*, including a stipend for a JRF, for a period of three years for continuing research work, provided the research proposal is considered worthy of such support. Preferential consideration may be given under partial travel grant scheme for attending international conferences.

Nominations for the awards for 1988 may be made by Fellows of the Academy, established scientific societies of all India character, University faculties and departments, or research institutions.

The *last date* for the receipt of nominations in the Academy is *November 15, 1987*.

Nomination Proforma can be obtained from the *Indian National Science Academy, Bahadur Saha Zafar Marg, New Delhi-110002* by sending a self-addressed envelope of 28 cm × 12 cm size. □

Articles published in this section are for students and general readers for understanding science in the perspective of its fundamentals. We invite science teachers and scientists for contributing articles to this section. Also we shall appreciate comments from our readers on the articles published in this section.—*Ed.*

A TECHNICAL ASPECT OF MANAGEMENT OF ANIMALS IN ZOOS

SOMA ROY*

A myth in the popular parlance prevails and the laity believes that animals in enclosures suffer and they suffer considerably because of the confinement. Even when untamed and untrained, animals get acclimatized and adjusted and conditioned in the zoo situations to a considerable extent.

When the present researcher, in course of one of her visits to a privately run zoo, got motivated to make a probe in some of the technical aspects of zoo management, her attention was automatically drawn to the enclosures in the zoos.

It has been found that the animals feel rather secure, sheltered and protected inside the enclosures. This can be substantiated from a study of the birds. Some birds escape from the enclosures and at the end of the day or even after days, they return to the enclosures. Their flight-back indicates not only conditioning but also a feeling security in a protected shelter.

Zoos are primarily meant for men, and not for animals. Animals are kept there confined for the purposes of men. Heini Heidigger states that the public are of supreme importance and together with the animals they are of primary consideration. Enclosures, therefore, have their necessity so that the animals

can be kept at a distance from the visitors for mutual benefit.

Incidentally, there is a popular idea that larger enclosures are easier to manage than smaller ones and these are more comfortable for the animals than smaller ones. The technical aspect of architectural design and engineering problem of the construction and maintenance of enclosures coupled with the question of comparative capital and recurring expenditure therefore deserve a methodical analysis and a thorough study.

From the point of view of those who manage the zoo, certain other aspects are also to be considered. "The ideal solution for a zoo is not to provide an exact imitation of the natural habitat but rather to transpose the natural conditions in wild, bearing in mind biological principles, into the artificial ones of the zoo". And, thus and, therefore, engineering and technical considerations should not be the only guiding principles in the matter of determination of the standards of the construction of cages and enclosures in a zoo. The multi-dimensional aspects of the problem require a scientific handling and the zoologists have a role to play herein.

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It has been reported by Miss Salley Walker, Chairperson of the Zoo Outreach Organisation, that, "The area being large it is more difficult to carry out minimum basic health checks of the animals." The "Stool and drool" check is a daily routine affair. Whether the bowel movement of a particular animal, specially a delicate one, is of the right quantity and consistency requires checking. Then, if the animal is drooling from the anal or urinary or oral or ocular regions, it is to be looked into and if any abnormality is detected, it is to be immediately reported and remedied.

In the old style prison like enclosures, generally built of brick masonry or concrete structure with iron grills or bars or wooden framing, the watching, checking, observation, examination and taking up of remedial measures are easy, less costly and less time-consuming. Moreover, collection of stool, urine, and other secretions, if required, are easy when the animals are kept in moderately sized enclosure of the old style. The feeding of animals, the collection of residuals, the cleansing and repairing of moderately sized enclosures are convenient. The BEEF formula of checking provides for Behaviour, Eating, Eyes, Faeces, Fur and Feathers. Miss Salley Walker, the noted organiser of zoo movement, has added another 'E' to the formula to indicate the necessity and importance of the routine checking of the Enclosure.

In a very big enclosure as in an open zoo, a real problem crops up when an individual animal is to be captured or segregated from a group for some reason or other. It may fall sick, may meet with an accident or may have to be taken out for sending elsewhere and it is rather difficult to recover it from the big enclosure. Extraneous objects thrown into larger cages by mischief-makers or sun-bekers among visitors are difficult to remove from a large cage. Convalescent, ailing and pregnant animals require constant watching and even nursing. It is easier to handle them in small and medium-sized enclosures.

In not-so-modern zoos cages generally

have two chambers so that animals can be trapped and confined in one chamber while the other may be repaired, cleansed and renovated.

The cost factor is also of tremendous importance. Particularly in the urban areas space is very much limited and the cost of the land is also very high.

But the zoologists' primary concern, along with that of the veterinary surgeons, are the physical and mental health and well-being of their charges, the mute animals.

The purpose of the instant paper *inter alia* has never been to deprecate and denigrate the open zoos and larger enclosures. Those have their utility, beauty, charm, advantages and particular suitability for certain animals. The purpose is simply to point out certain basic positive sides of the small and medium-sized cages and enclosures. But an iota of modernity may have to be added to prevalent cages to make them befitting for the inmates of the zoo in the light and context of the available advanced knowledge regarding lifestyle, habit and needs of the creatures of nature.

In the Indian context, when paucity of funds is a problem of great magnitude, it is felt that medium sized old-style cages and enclosures may have to be retained with minor adjustments. A new orientation is perceptible and the trend may be encouraged while constructing new enclosures, but old enclosures may not be discarded for the time-being for their inherent suitability as enumerated hereinabove.

Incidentally, in the designing and construction of architectural patterns of the cages and enclosures of varied shapes and sizes, certain basic considerations should not be overlooked inasmuch as the height and space, the dimensions, the ventilation, the inlets and outlets for water and the afforded protection from the hazards of nature etc., contribute much, positively or negatively, to the health of the animals.

For certain animals adequate space must be provided horizontally, and vertically for some others. Let me suggest a watch-word

for consideration of the zoo authorities which may help them in their onerous task of zoo keeping. The watch-word is S O S wherein S

stands for Safety of visitors and Security of animals, O for Organizational efficiency and S for Scientific display of animals. □

Letters to the editor

Mustard seedling bait method—A new technique to isolate vesicular arbuscular mycorrhiza (VAM)

Mycorrhizal fungi live in association with plant roots, and have many beneficial effects on their host plant. They may be ecto or endotrophic. The nonseptate endomycorrhizal symbionts are called vesicular arbuscular mycorrhiza (VAM), as they penetrate the cortical cells and form large vesicles and arbuscles intracellularly.

It is possible to isolate ecto, and some endomycorrhiza of orchids on laboratory media, but attempts for the successful isolation of VAM in the laboratory have failed¹⁻³. They are, therefore, maintained in pure culture on the roots of certain plants, usually perennials.⁴

An effort was made to evolve a method of isolating and culturing these fungi in the laboratory. It was observed that roots of mustard plants—*Brassica campestris* Linn, (cv. *varuna*) became mycorrhizal when grown in the presence of spore cultures of VAM fungi such as *Glomus mosseae*, *Glomus fasciculatus*. This led to the germinated mustard seeds to be used as baits for the investigation and isolation of VAM from plant roots. The technique is named as mustard seedling bait (MSB), and was standardized using known spore cultures of VAM.

For isolation of VAM, roots of *Lantana indica* Roxb., *Ipomea fistulosa* Mart ex-Choisy, *Themeda quadrivulva*, Linn and *Guizotia abyssinica* Cass. growing in a grassland were selected. Pieces of roots (0.5 to 1.0 cm long) were taken, washed thoroughly with sterilized distilled water (3-4 times), followed by washing with 1.0% chloramine T, and again with sterilized distilled water (3-4 times) in order to remove all traces of the detergent. The root pieces were taken in a sterile Petri plate, crushed with a forceps, and the extract thus obtained was placed near the mustard seedlings kept on plain agar (2% agar in distilled water). Two seedlings were placed per plate. After 3-4 days of incubation at 28°C, mycorrhizal association was found to develop showing extramatrical hyphae and typical chlamydo-spores. As a long incubation period cannot be provided in this technique, due to limited growth being permitted in the Petri plate the development of arbuscles and vesicles was not seen, as they take a longer time to develop. The pure culture of mycorrhiza was maintained on plain agar without any contamination since the medium was devoid of extra nutrients. Earlier, these plant roots from which isolations were made did not show the presence of mycorrhiza under the microscope or when cultured on Potato Dextrose Agar plates.

This simple method can be used for the isolation, identification and maintenance of many VAM fungi. Their identification can be done on the basis of their spores, stalk attachment and other morphological characteristics. It is a cheaper and quicker method

And gives better results as compared to the earlier technique.⁵

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Received : 17 October, 1986.

Revised : 2 March, 1987.

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The presence of calcium, pectic substances and proteins in resistance of cauliflower leaf due to infection by *Alternaria brassicicola*

The pathogen, during establishing itself on host, first encounter the cell wall barrier of the host and is characterised in its ability to produce complex of enzymes capable of degrading the complex polysaccharides of the host cell wall¹⁻⁴. The pectic substances, one of the important polysaccharides, in association with calcium and proteins, are the major important constituents of middle lamellae of the cell wall. The association of calcium with pectic substances in relation to resistant against fungal infection has been opined by several investigators⁵⁻⁸. In the present investigation, the concentrations of pectic substances, calcium and proteins in the cell wall of cauliflower leaves of four varieties

have been estimated in order to throw some light in this topic.

The cauliflower seeds of BOB 3208 and BOB 4209 cultivars were obtained from Dept. of Agriculture, Govt. of West Bengal and those of Snowball and late Banaras from M/s Sutton & Sons Ltd., Calcutta.

Cultivation of plants—Cauliflower seedlings (*Brassica oleracea* var. *botrytis*) of resistant and susceptible varieties were grown in 25 cm diameter earthen pots. Seeds previously treated with agrosan (a mixture of phenyl mercuric urea and ethyl mercuric chloride with total mercury content 1%) were sown in sterilised soil. Ammonium nitrate was supplied usually 12 days after germination at the rate of 40 kg nitrogen per hectare.

Inoculation procedure and assesment of disease intensity were done following the procedures described previously by Maitra and Samajpati⁹. The typical disease symptoms were found to develop after 7-10 days of inoculation. The seedlings used for the present investigation were 15-20 days old. The cell wall was prepared from 30 days old seedlings following the method of Ito and Fujiwara¹⁰. Pectic substances were determined colorimetrically by the method of McComb and McCready¹¹ and McCready and McComb¹². Calcium was determined following the method of Vogel¹³. Protein content was calculated following the method of Lowry *et al.*¹⁴

The data in the table 1 clearly indicate that though the pectic substances of the four varieties are more or less similar, yet the

TABLE 1 : Pectic substance, calcium and protein contents in cell walls of leaves of four varieties of cauliflower*

Cauliflower leaves		Pectic substance	Calcium	Protein
cultivars	Type			
BOB 3208	Resistant	11.25 ± 0.24	13.75 ± 0.25	54.2 ± 2.2
BOB 4209	Resistant	12.16 ± 0.20	13.60 ± 0.26	49.6 ± 1.8
Snowball	Susceptible	12.35 ± 0.16	11.24 ± 0.22	40.5 ± 1.4
Late Banaras	Susceptible	12.50 ± 0.17	10.97 ± 0.26	35.6 ± 1.2

*Results have been expressed in mg/g dry cell wall materials. Each value represents an average of five separate determinations S.E.m.

Calcium and protein contents are significantly higher in the resistant varieties than in the susceptible ones (Table 1). The importance of calcium in the maintenance of physical integrity of plant cell walls is well demonstrated^{10,15}. The role of calcium associated with other cell wall constituents like cell wall proteins is also important¹⁵. In the resistant varieties of cauliflower, pectic substances possibly undergo conformational changes to enable their many more reactive groups to form cross linkages with increased levels of calcium and proteins and making the cell walls invulnerable to pathogenic enzymatic attack¹⁵.

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Revised: 27 May, 1987.

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A new technique of disease indexing for potato

In Meghalaya during potato season when the temperature and humidity are more than 10°C and 75% respectively the late blight appears usually at the end of May, but when any of the conditions are not fulfilled the late blight appearance is delayed¹⁻³. Also, the unfavourable weather during disease development checks the rate of spread. The basic requirement of any disease assessment is that it should provide a practical degree of accuracy, and the results should be comparable from worker to worker, location to location and from season to season.

The experiment was conducted at Central Potato Research Station Shillong, Meghalaya with the objective of working out a suitable and easy scale of disease indexing where experimenters' bias could be minimised. A total of 322 genotypes of diverse late blight resistance were tested. They were planted during 1980 and 1981 in rows with Kufri Chandramukhi and Upto Date as the susceptible checks at regular intervals. The observations were recorded on date of late blight appearance, disease progress and ultimate killing of foliage.

The duration of disease (from infection to death of plant) ranged from 8 to 60 days in 1980 and 10 to 70 days during 1981. Highly resistant cultivars took much more time as compared to susceptible cultivars. This duration seemed to be directly related with the resistance mechanism. Van der Plank⁴ indicated that the rate of infection (r) was much more important from resistance point of view. The disease indexing data (1980 and 1981) showed that Kufri Chandramukhi and Up-to-Date being highly susceptible cultivars took up to 8 days in 1980 and 10 days in 1981 respectively. This variation with no resistance of cvs. very well reflected the environmental effect on the disease development. The genotypes in other categories of resistance also took proportionately more time during unfavourable season of 1981.

Simple mathematical calculation showed the following relationship :

$$\text{Resistance} = \frac{t_s}{t_n} \times ng$$

where—

Resistance—represents the degree of late blight resistance of the test cultivar.

t_s —number of days required for 100% killing of foliage of the highly susceptible cultivar.

t_{max} —number of days required for killing of foliage of test cultivar.

ng —represents the number of disease scoring grades which has been kept as 5 in present studies.

TABLE 1: Late-blight indexing during 1980-81 on the basis of time-scale

Sl. No.	Number of cultivars studied	Number of days in 1980	Number of days in 1981	Disease score
1	32	11 or less	15 or less	5
2	45	12 to 14	16 to 20	4
3	109	15 to 20	21 to 28	3
4	106	21 to 34	29 to 46	2
5	30	35 or more	47 or more	1

(the disease indexing grades could be changed according to convenience by changing the value of ng so as to get the narrow range differences).

The table 1 indicated that level of resistance in genotypes did not change from year to year although the number of days taken for 100% killing of foliage was different. The conventional method of visual assessment may sometimes categorise the susceptible as resistant under unfavourable weather conditions which might be erroneous. This scale can also be used for the determination of resistance erosion which is quite common in case of horizontal resistance.

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Seedling infection of tomato by *Pythium echinulatum*

During the present study on seed-rot and seedling diseases of certain vegetable crops of Kumaun hills, heavily infected (with *Pythium echinulatum*) roots of tomato (*Lycopersicon esculentum* Mill.) were collected from the fields. They were washed in running tap water for 20 minutes, treated for 30 seconds in 0.5% NaOCl solution, rinsed, cut into small pieces and plated on agar plates¹. After seven days of incubation at room temperature (22°C), the *Pythium* colonies were transferred to sterile hemp seed halves in sterile water to facilitate identification, which was based on the keys of Middleton² and Robertson³. Confirmation was made from C. M. I. Kew, England (IMI—277400).

Pathogenicity of *P. echinulatum* was tested on seedlings of tomato. The fungus was grown on corn meal agar (CMA) for four days and then agar discs (8 mm. diameter) containing mycelia and reproductive bodies were taken from the culture and used as inoculum. Surface sterilized, healthy seeds were sown in sterile pot soil. Each pot was inoculated with 8 agar discs. The inoculum discs were placed in the pot soil and simultaneously the seeds were also sown (20 seeds/pot—10 replicate pots)⁴. Control pots of seedlings were maintained without the inoculum. All the pots were kept on the glasshouse bench at temperature 25±2°C.

Disease incidence was noticed in the fields as pale yellow discoloration, curling of mature leaves followed by sudden wilt and death of young plants in nursery beds.

Robertson⁵ artificially inoculated seedlings with the aforesaid pathogen and found it to be a weak pathogen. During the present study, *P. echinulatum* was isolated from

tomato fields both as pre- and post-emergence damping-off pathogen. This fungus was found to be a destructive pathogen which caused 60 to 65% loss to growing seedlings of tomato. *P. echinulatum* as a pathogen of tomato plants is being reported for the first time from India.

Financial assistance from C. S. I. R., New Delhi is gratefully acknowledged.

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Received : 17 November, 1986.

Revised : 10 March, 1987.

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**A preliminary report on the mite fauna
associated with water hyacinth
(*Eichhornia crassipes*) in
eastern Uttar Pradesh**

The water hyacinth (*Eichhornia crassipes*) is a very noxious weed and cause serious problem when it colonises small or large bodies of water which are useful for irrigation, water supply, fish culture and many other purposes. It may also serve as breeding grounds and dispersal agents for pests of cultivated plants and for vectors of human, animal and a plant diseases. Of the different methods of control which have been recommended for checking this weed, biological control is receiving increasing attention because of certain advantages which it offers over other methods. Large numbers of organisms have been recorded on *E. crassipes* in neotropics¹. Of these, two species of lepidopterous borer, two species of weevils and a mite *Orthogalumna terebrantis*

wallwork (Galumnidae : Cryptostigmata) proved to be the most suitable candidates for further studies and field trials in other areas. Earlier insects and pathogens attacking water hyacinth in India has been summarised². However, information on the mites associated with water hyacinth in India is very meagre. The present study is, therefore, undertaken to survey the mite fauna associated with water hyacinth in eastern Uttar Pradesh.

In the present investigation a survey on mite fauna associated with water hyacinth (*Eichhornia crassipes*) was undertaken in 1984-85 in eastern Uttar Pradesh. The water hyacinth plants along with roots were brought to the laboratory. The shoot and root portion of the plants were chopped into pieces and kept separately in the Tullgren funnel for 24-28 hrs. for extraction of mites. The mites were collected in 70 per cent alcohol. The leaves were subjected to microscopic examination immediately after their collection. For taxonomic studies, mites were transferred to the clearing medium prepared by mixing equal volumes of ethyl alcohol and lactic acid. The cleared specimens were mounted in Hoyer's medium and identified.

The mites obtained during the present survey is a preliminary report on the mites associated with water hyacinth in Uttar Pradesh. The examination of the collection revealed the existence of eight species distributed over four sub-order, eight families and eight genera. The mites found on hyacinth were identified as *Hydrozetes terrestris* (Hydrozetidae : Cryptostigmata); *Trimalaconothrus heterotrichus* (Malaconothridae : cryptostigmata); *Scheloribates* sp. (Oribatulidae : Cryptostigmata); *Lasioseius* sp. (Ascidae : Mesostigmata); *Ololaelaps* sp. (Laelapidae : Mesostigmata); *Cunaxa* sp. (Cunaxidae : Prostigmata); *Eutetranychus orientalis* (Tetranychidae : Prostigmata) and *Tyrophagus putrescentiae* (Acaridae : Astigmata). Out of these mites, *Hydrozetes terrestris* and *Trimalaconothrus heterotrichus*

ohus are being reported for the first time from India.

Most of the mites were found in the decomposed root and shoot portion of the plant except *Tyrophagous putriscentiae* which was found on the ventral surface of the leaves. Numerically, density of *Hydrozetes terrestris* and *Trimalaconothrus heterotrichus* were higher followed by *Lasioseius* and *Ololaelaps* sp. Only a few numbers of *Eutetranychus orientalis*, *Cunaxa* sp. and *Tyrophagous putriscentiae* were observed.

In recent years many workers have concentrated their effort to control water hyacinth by biological agents. Exploratory survey have been carried out to record the insects and mites associated with *E. Crassipes* and *Salvinia* sp. in the neotropics and to evaluate the promising species which could be safely introduced into other areas to control these weeds¹. Among the natural enemies recorded, galumnid mite, *Orthogalumna terebrantis*, is considered to be most promising agent for further trials. Feeding marks produced by this species on water hyacinth leaves were so prominent that many workers recommended this mite as one of the effective biological control agents of this weed²⁻⁶. However, this mite was not encountered during the present survey.

Hydrozetes sp. found in the present investigation was earlier recorded on aquatic plants, wet moss and floating sphagnum⁷, often crawling on the underside of leaves. Immature and adults of *Hydrozetes* sp. (possibly *H. lemnae*) have been observed on damaged or deteriorating leaves of aquatic plant *Salvinia rotundifolia* in Florida⁸. However, it is not clear whether the mites contribute to primary leaf injury or simply feed on previously damaged tissue or on related bacterial or fungal invaders. Therefore, more intensive studies are needed to establish the feeding habits of *Hydrozetes terrestris*.

The authors express their sincere thanks to Dr. J. A. Wallwork, Queen's Mary

College, Department of Biological Science, University of London, London and Dr. S. K. Gupta, Zoological Survey of India, Calcutta for identification of the species.

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Revised: 9 March, 1987.

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Photosynthesis in leaves of sunflower (*Helianthus annuus*) as influenced by their position

In sunflower, the growing sink depends for its assimilate supply largely on the top few leaves and bracts proximate to head^{1,2}. The pattern of carbon fixation in dicotyledonous leaves is age dependent and there are variable results on the duration of leaf photosynthesis in sunflower³. In the present experiment, an attempt has been made to study whether there is any difference in the photosynthetic activity amongst top three fully developed leaves due to their position on the stem. Data on stomatal resistance

and chlorophyll content have also been reported.

Healthy seeds of sunflower (Var. BHS-1) were grown in cemented pots during winter season (Oct.-Jan.). Only two plants in each pot were maintained throughout. Normal cultural practices were followed as and when required. Measurements of photosynthetic activity were done with the help of Infra Red Gas Analyser (ADC England) for the first, second and third top fully developed leaves. Stomatal resistance of the same leaves were measured by Autoporometer (Licor 1600). Chlorophyll contents were determined in the leaves of corresponding plants following the method described elsewhere⁴.

Photosynthetic curve as shown in Fig. 1, show two peaks during the entire life span

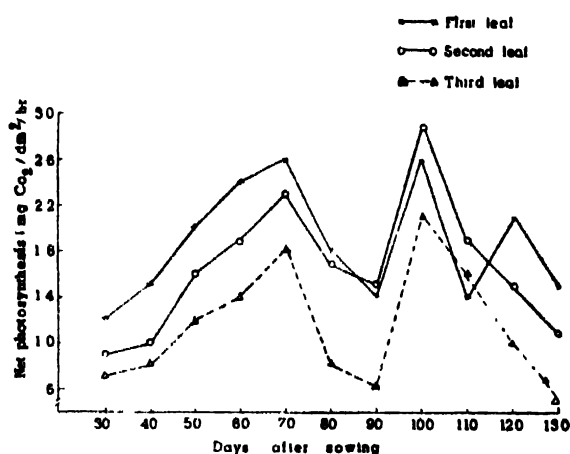


Fig. 1. Photosynthetic rate ($\text{mg CO}_2/\text{dm}^2/\text{hr}$) in top three fully developed leaves during growth and development.

in all the three leaves. The first peak coincided with the active vegetative period while the other appeared at the time of reproductive differentiation. Similar results have been published earlier¹. In soybean also two peaks were reported, the first peak appearing at flowering time while the other at pod filling stage⁵.

Among the three leaves, the highest photosynthetic rate was noticed in the first leaf followed by second and third respectively. The diffusion resistance curve showed an opposite trend i.e. highest stomatal

resistance was noticed in the third leaf followed by second and first (Fig. 2). Chlorophyll content in the leaves continuously

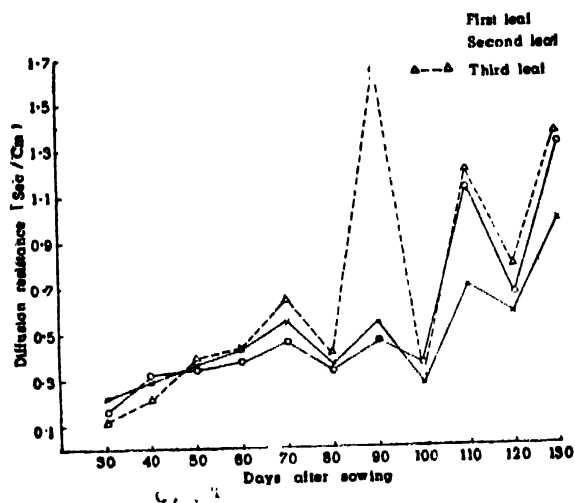


Fig. 2. Diffusion resistance (Sec/cm) in top three fully developed leaves during growth and development.

increased up to 90 to 100 days from the date of sowing and thereafter it declined (Figs. 3 & 4). Amongst the three leaves, the first

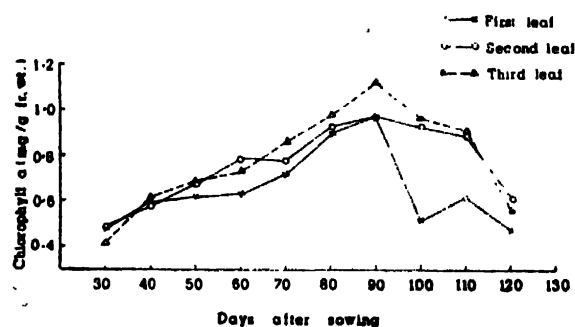


Fig. 3. Chlorophyll a content (mg/g Fr. Wt) in top three fully developed leaves during growth and development.

top leaf showed to have comparatively less chlorophyll a content throughout while second and third showed almost the same chlorophyll contents. As far as chlorophyll b content is concerned there was not much difference amongst the three leaves.

From these results it appeared that the top three leaves have different rates of photosynthesis and diffusion resistance. The first leaf being the most active followed by second and third respectively. Stomatal resistance was inversely related to photosyn-

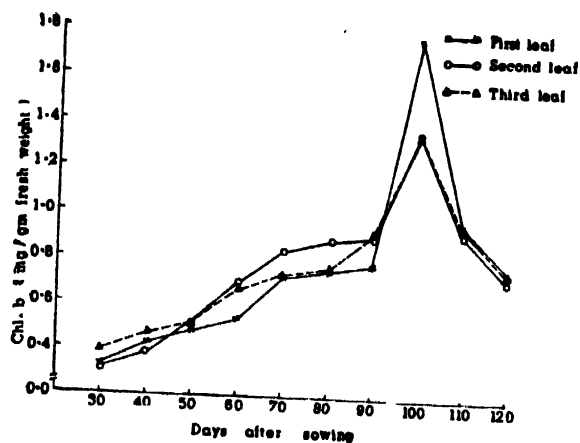


Fig. 4. Chlorophyll b content (mg/g Fr. Wt) in top three fully developed leaves during growth and development.

thetic activity particularly at later part of growth. There was no definite relationship of chlorophyll content in the leaf with the photosynthetic rate.

It has been reported in soybean that the rate of maximum photosynthesis in the leaf vary with the leaf position on the stem⁶. Sestak has stated that each successively formed leaf on a plant passes through a course of ontogenetic changes in photosynthetic characteristic and they differ in photosynthetic rate⁷. In the present studies the difference in photosynthesis in the three leaves may be due to changes in morphology, cell ultrastructure, chemical composition and metabolic activity⁸.

This research work has been financed partly by a grant made by the United States Department of Agriculture, Office of the International Cooperation and Development, authorised by Public Law 480.

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Revised : 4 May, 1987.

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Effect of phosphorus and potassium on Indian rape on rice fallows in Gangetic delta region

In the southern parts of West Bengal and its coastal area, there exists a vast tract which is traditionally a monocropped area growing rice rainfed during June to December and rest of the year lands remain vacant till the next *aman* (Wet season) rice is sown in the succeeding year. To make greater exploitation of land and man resources, the utilization of more and more rice fallows with introduction of oilseed crop like rape seed (*Brassica campestris* var. yellow Sarson) having wider adaptability and high yield potential will go a long way to fit the crop well in the cropping pattern after harvest of *aman* rice under gangetic delta region of South Bengal and thereby meet the demand of edible oils of the people of the area. Among the major nutrients, though N has got certain decisive influence on rapeseed, the effect of P and K on this crop has yet not been ascertained under gangetic delta agroclimatic conditions. The present study, therefore, was undertaken to find out the effect of P and K on rapeseed.

The experiment in a factorial design was carried out of the Agricultural Research Farm of Calcutta University, Baruipur, South 24-Parganas during winter season (December-February) of 1985-86 on gangetic alluvial deltaic soil having 0.718% organic carbon, soil pH 6.5, available P and K 25 and 370 kg/ha respectively. The treatments comprised four levels of P (0, 30, 60 and 90 kg/ha) and 3 levels of K (0, 25 and 50 kg/ha).

A common dose of N at 80 kg/ha to all plots, 2/3 as basal and remaining 1/3 as topdressing at 30 days of growth was applied. The test crop was rapeseed (yellow sarson) cv. B-9. Recommended agronomic practices were adopted for raising the crop.

The results of the investigation revealed a noteworthy feature of P and K fertilization on Indian rape grown under gangetic delta region. The treatment without supply of P (P_0) resulted in stunted and reduced plant growth and consequent to mortality of plants

The probable reasons seem to be that application of higher rate of K in the form of KCL might reduce the absorption of N, S and P and or disturb water relation in plants and thereby the protein synthesis as well as anabolic and metabolic activities in plants are adversely affected consequent to reduction in seed yield³⁻⁴. Increase in oil content in seed under higher rate of P but reduction at more supply of K corroborate the findings of Nelson *et al.*⁵ and Onishchenko⁶ in many oilseed crops.

TABLE 1 : Effect of phosphorus and potassium on yield components and yield of rapeseed

Treatment	Number of silique/ plant	Length of silique (cm)	Number of seeds/ silique	1000-seed weight (gm)	Seed yield (q/ha)	Oil per- centage
Phosphorus level (kg/ha)						
P_{30}	36	3.73	19	3.05	3.85	34.21
P_{60}	37	3.73	20	3.26	4.36	38.22
PP_{90}	47	3.90	22	3.53	7.83	39.77
C. D. 5%	0.70	0.12	1.25	N. S.	0.66	2.23
Potassium level (kg/ha)						
K_0	37	3.65	20	3.08	5.61	35.88
K_{25}	47	3.89	21	3.53	7.23	39.10
K_{50}	40	3.85	20	3.22	3.40	37.22
C. D. 5%	0.70	0.12	1.25	N. S.	0.66	2.23

at advanced stage of growth presumably due to retarded protein and protoplasm synthesis as well as disturbances in the process of photosynthesis under deficit supply of soil P. Increased P levels have shown a highly positive influence on yield components of rapeseed (Table 1). The crop, however, has not been able to withstand K over 25 kg/ha in as much as there has been marked decline in almost all the yield components of rapeseed under K over 25kg/ha. Such effects of P and K on yield components of oilseed crops like sesame and rapeseed have been reported by Singh *et al.*¹ and Majumdar and Sandhu² respectively. Increasing rate of P from 30 to 90 kg h⁻¹ has given significantly higher seed yield, while moderate rate of K at 25 kg h⁻¹ is more effective than higher level (50 kg h⁻¹).

Thus, the foregoing results suggest that liberal supply of P and judiciously moderate rate of K application can push up the yield of rapeseed on rice-fallows.

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Received : 16 December, 1986.

Revised : 9 March, 1987.

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New Records of parasitoids of Ber hairy caterpillar *Thioidas postica* Wlk. in Kolhapur, India

Thioidas postica Wlk. is pest of Ber tree *Ziziphus* sp. in Kolhapur district of Maharashtra, India. During a survey of natural enemies of *T. postica* extensive collection of its larvae, pupae and cocoons were made. The laboratory screening showed three parasitoids (Table 1).

TABLE 1: Natural enemies of *Thioidas postica* Wlk. in Kolhapur

Parasitoids	Family	Stage of attack
<i>Apanteles creatonoti</i>		
Viereck	Braconidae	Larval
<i>Charops</i> sp.	Ichneumonidae	Larval
<i>Tachina (Exorista) fal'ax</i>		
Meigen	Tachinidae	Larval

A. creatonoti is solitary parasitoid and appears soon after the pest. Early second instar larvae preferred for parasitization, upto 30% parasitism was recorded by this species. *Charops* sp. observed after a month of pest appearance. It parasitizes second instar caterpillars of *T. postica* with 15% parasitism. Tachinid fly show less (8%) parasitism. The above species are recorded for the first time as a parasitoids of *T. postica* in India¹⁻⁴.

Author is thankful to CSIR, New Delhi for financial assistance and Prof. A. T. Varute, Head, Department Zoology, Shivaji University, Kolhapur for providing facilities.

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Received : 28 October, 1986.

Revised : 9 January, 1987.

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Differentiation of sex at pupal stage in *Danais cryssipus* (Linn.) (Insecta : Lepidoptera)

Present communication deals with the characters by which the male and female pupae of *Danais cryssipus* could be identified. Segregation of pupae of *Trichoplusia* by sexes is also on record¹.

Danais cryssipus, a spotted butterfly is found on the calotropis plants. The caterpillars were collected from the college campus at Vidisha (M. P.) during March-June '86. The caterpillars were fed daily on tender leaves of calotropis. They pupated on the lower surface of the jars in which the caterpillars were kept at room temperature and R. H. 40% \pm 1. Generally, after three days the cocoon became cream colored but some brownish cocoons were also seen. The cocoons were cylindrical tapering at the posterior end. At about one third of the anterior region, there is a ring formed on the third day of pupation. In female cocoons bright spots (Fig. 1a) are formed on the dorsal

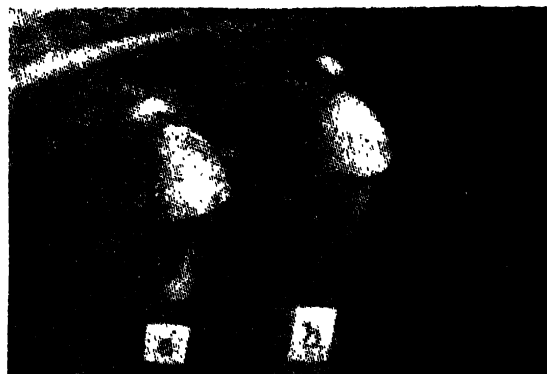


Fig. 1. (a) Female cocoons showing small knob at the anterior end and some spots at the ring on the dorsal surface; (b) Male cocoons showing a large knob at the anterior end with a pit at the middle on the ring at dorsal side. Colour difference between the two is also seen.

surface of the ring, while in the male a small groove or pit is formed in the middle of the ring on the dorsal surface and the spots are less brighter (Fig. 1b).

At the time of emergence of the butterfly,

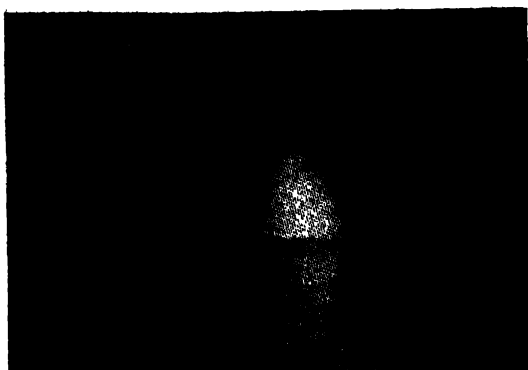


Fig. 2. Female cocoons at third day of pupation showing bright spots at the rings on the dorsal side.

a small ridge is formed in the female cocoons though it is not well defined in males. After emergence, adults have three large spots on each of the wings in female and four in male butterfly.

Thanks are due to the U. G. C., New Delhi for financial assistance to one of the author (RCS) vide grant no. 571.

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Cecidogenesis and leaf sheath pigmentation

Gall midge (GM), *Orseolia oryzae* (Wood-Mason) is one of the most economically important insect pests of rice during Kharif, in Madurai, India¹. Larval feeding within the culm base, causes the formation of the abnormal structure—"galls". Cecidogenesis, caused by the suppression of leaf primordial differentiation in the growing points and development of radical ridges from the inner most leaf primordium, followed by leaf sheath elongation, is considered as a highly developed form of phytophagy. Recent

studies and closer examination of galls in different rice varieties, showed various colour intensities, ranging from purple to green². This led us to investigate as to why this happens and also to know, whether GM attack causes chlorophyll destruction.

The optical density of the pigment extracts from leaf sheaths (purple and green) and galls of Ariyan rice variety was determined by a spectrophotometer at 645 nm and 663 nm. Eighty per cent acetone was used as blank. The total chlorophyll content (C) present in the extract was calculated according to the formula :

$$C \text{ (mg/litre)} = 20.2 \times D_{645} + 8.02 \times D_{663}$$

where D663 and D645 are absorbance at 663 mu and 645 mu, respectively.

It was observed that galls from purple leaf sheath had a purple pigmentation. However, several galls had a purple tip beneath the vestigial leaf blade. This distinctive feature might arise from the migration and concentration of pigments in the leaf sheath. This also confirms that colour of gall varies with the leaf sheath pigmentation and also the role of leaf sheath in Cecidogenesis. Various plant parts (Table 1)

TABLE 1: Total Chlorophyll content of Ariyan rice Variety

Plant Part	Absorbance at		Total chlorophyll (mg/lit.) ^a
	645 nm	663 nm	
Leaf sheath (purple)	0.038	0.030	1.00
Leaf sheath (green)	0.048	0.041	1.30
Gall (purple)	0.061	0.042	1.60

^aAverage of 3 replications.

estimated for cecidogenesis suggests that the damage by the GM slightly increased the C titres in the gall and this is perhaps due to increased activity of the chloroplast, for increase demand by the developing larva for nutrition. However, the active growth and intense protein synthesis in cecidogenesis

has been related to the time of adult emergence.²⁻⁴

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Post-bloom thinning of subtropical peaches with 'Planofix'

Florida peaches are becoming popular with North Indian growers under subtropical conditions. Under this climate, the trees grow vigorously and bear prolific fruit crop. This leads to limb breakage and production of small sized fruits of poor quality. Fruit thinning is a standard practice in temperate areas for production of quality peaches¹. Under subtropical climate to replace the laborious practice of hand-thinning, not much information is available on the chemical thinning of peach fruits. In view of this, Flordasun cultivar of peach was sprayed with Planofix (Sodium salt of 1-naphthylacetic acid, NAA).

The investigation was carried out in the Department of Horticulture, Punjab Agricultural University, Ludhiana during 1985. Planofix obtained from (May and Baker (Idia) Ltd., Bombay) was sprayed at the concentrations of 0, 25, 50, 75, 100 and 200 ppm on eight-year old peach trees of cv. Flordasun. The spraying was done at the petal-fall stage of full-bloom period during February. There were six treatments with

three replications in each. The experiment was laid out according to the Randomized Block Design on nine trees. At harvest, observations were recorded on per cent fruit retention and physico-chemical characteristics of fruits.

It is evident from Table 1 that per cent fruit retained at harvest declined considera-

TABLE 1: Effect of 'Planofix' on the physico-traits of peach cv. Flordasun

Treatment of Planofix (ppm)	Fruit retention (%)	Fruit wt (gm)	Pulp wt (gm)	Stone wt (gm)	Pulp/stone ratio
Control	68.62	71.90	67.50	4.40	15.34
25	63.13	96.60	51.30	5.30	17.23
50	54.96	97.44	92.02	5.42	16.97
75	50.44	93.04	87.82	5.22	16.82
100	38.08	89.24	84.07	5.17	16.26
200	26.40	90.24	84.92	5.32	15.96
C. D. at 5% level	15.72	4.79	5.34	0.54	—

bly with increasing concentration of Planofix as compared sprayed control trees. Significantly greater fruit retention of 63.18% was obtained with 25 ppm spray as compared with all other treatments except 50 ppm (54.96%). Moreover, 100 and 200 ppm concentration showed over-thinning of fruits burning of foliage was noticed with 200 ppm. In earlier reports, α -NAA sprays at 200 ppm completely defoliated Regina and Early Red Haven peaches^{2,3}. When Cardinal and Red Haven peaches were sprayed at ovule length of 8.7-9.2 mm in opened flowers, the 60 ppm concentration of NAA caused over-thinning of fruits⁴. The effective thinning with 400 ppm Na-NPA, 5 days after full bloom or 500 ppm NAA during flowering was also noticed⁵. However, Na-NPA caused considerable tree damage. The variation in dose response may be mainly due to the varietal, age differences of peach trees and the stage of application of bloom period. Secondly, the prevailing climatic conditions of the area also regulated the dose response of growth regulators.

Highest fruit weight of 97.44 gm was obtained from trees sprayed with 50 ppm 'Planofix', whereas the greater pulp/stone ratio of 17.23 was noted in the fruits borne by the trees sprayed with 25 ppm solution (Table 1). The results of both these treatments were significantly higher than the control and 200 ppm treatment. However, the fruit weight, pulp/stone ratio with 25 and 50 ppm applications did not differ significantly and were almost at par with each other.

TABLE 2: Effect of 'Planofix' on the biochemical constituents of peach cv. Flordasun

Treatment of Planofix (ppm)	T.S.S. %	Total sugars (%)	Acid content (%)	Pectin (Ca pectate) (%)	Vit. C mg/gm
Control 0	10.20	7.10	0.84	0.18	7.85
25	11.80	7.80	0.75	0.19	8.15
50	11.15	8.72	0.70	0.19	8.15
75	10.62	7.70	0.81	0.18	7.08
100	9.40	7.30	0.73	0.17	7.48
200	9.80	7.51	0.81	0.19	7.90
C. D. at 5% level	1.18	N.S.	N.S.	N.S.	N.S.

From Table 2, it is evident that 'Planofix' application did not affect significantly the quality characteristics except T. S. S. Higher T. S. S. values of 11.80 and 11.15% were recorded in the fruits with 25 and 50 ppm but these did not differ significantly themselves. However, 25 ppm application was significantly superior than control; 75, 100 and 200 ppm treatments. The effect of 'Planofix' sprays on total sugars, acid content, pectin and Vit. C did not differ significantly. However, the higher values of total sugars (8.72%) and pectin (0.19%) and Vit. C (8.85 mg/gm) were recorded with 50 ppm 'Planofix' application. This was followed by 25 ppm treatment.

On the basis of foregoing results, the application of 25 and 50 ppm 'Planofix' are beneficial over its higher doses and control treatment as far as the fruit retention and

marketable fruit yield is concerned. These treatments may be useful in minimizing labour cost on the fruit-crop improvement with manual fruit thinning.

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Received : 12 December, 1986.

Revised : 2 March, 1987.

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Efficiency of urea and slow-releasing nitrogenous fertilizer formulations in irrigated wheat and wet season rice cultures

Urea is considered the most popular form of nitrogenous fertilizer. In spite of this popularity employed by urea, leaching¹ and volatilisation² losses limit its usage particularly in conditions pertaining to wet-land rice. Consequently, scientists have developed fertilizers with slow-releasing characters namely, sulphur coated urea, lac coated urea, supergranulated urea and urea formaldehyde. We, in our laboratories have developed a few types of new slow-releasing urea fertilizer materials which involve in preparation of matrix-bound urea-saw dust formaldehyde complex, coating ureaform with bitumen, which was abundant source in India. In order to study the effect of these fertilizers in contrast with urea, field trials have been conducted at Calcutta University, Agricultural Experimental Farm, Baruipur, on irrigated wheat (November to March of 1982-83 and 1983-84) and wet-season rice (June to October of 1983-84 and 1984-85). The experiments were carried out in a simple

randomised block design with nine treatments each replicated three times. All plots received one basal application of 100 kg N/ha except that of the control treatment.

Data given in tables 1 and 2 reveal that N recovery both in cases of wheat and rice

yield than that of U. Fertilizer efficiency has been considerably increased in cases of SCU, BCUF, SUF and UF with SCU and BCUF having almost equal effect.

An interesting aspect that has taken place is that the conditions pertaining to wheat

TABLE 1 : Effect of slow-release urea materials on grain yield, fertiliser efficiency of irrigated wheat

Treatment	Grain yield (q/ha)	Straw yield (q/ha)	Total N uptake (kg/ha)	Fertiliser efficiency (%)	Soil efficiency (%)	Priming effect
C	13.36	11.96	26.91	—	1.72	—
U	23.00	20.17	64.97	38.06	4.16	2.44
USG	23.74	20.36	67.25	40.34	4.31	2.59
NU	24.98	20.59	69.59	42.99	4.43	2.76
LCU	25.95	21.27	73.33	46.42	4.70	2.98
SCU	35.38	23.71	102.11	75.20	6.54	4.82
BCUF	34.59	23.60	100.49	73.58	6.44	4.72
SUF	31.81	22.42	92.57	65.66	5.93	4.21
UF	30.65	22.54	90.31	63.40	5.78	4.06
Mean	27.05	20.73	76.42	55.70	4.89	3.57
S. Em (±)	4.35	7.65	7.82	5.43	0.50	0.34
CD (5%)	2.98	3.65	—	—	—	—

TABLE 2 : Effect of slow-release urea materials on grain yield, fertiliser efficiency of wetland rice

Treatment	Grain yield (q/ha)	Straw yield (q/ha)	Total N uptake (kg/ha)	Fertiliser efficiency (%)	Soil efficiency (%)	Priming effect
C	19.58	28.71	34.38	—	2.09	—
U	29.42	38.98	58.31	24.03	3.55	1.46
USG	30.53	30.23	60.69	26.41	3.70	1.61
NU	32.94	42.98	70.41	36.13	4.29	2.20
LCU	33.36	43.36	77.48	43.20	4.72	2.63
SCU	39.06	49.01	94.89	60.61	5.78	3.69
BCUF	38.63	47.51	93.64	59.36	5.70	3.61
SUF	36.62	45.65	85.76	51.48	5.22	3.13
UF	36.18	45.17	84.60	49.37	5.15	3.06
Mean	32.92	42.31	70.81	43.45	4.46	2.67
S. Em (±)	6.59	6.85	6.82	5.13	0.39	0.30
CD (5%)	3.65	3.72	—	—	—	—

appeared to be lowest in control (C) followed by urea (U), urea super granule (USG), neem urea mixture (NU) and Lac coated urea (LCU). Sulphur coated urea (SCU), Bitumen coated urea form (BCUF), Saw-dust urea formaldehyde (SUF) and Urea formaldehyde (UF) recorded significant increases in grain

showed more N recovery than that of rice with all cases of treatment. Such differences of recovery values may be attributed to the water that plays a role in reducing of efficiency of urea-N in wet-land rice³. This role of water is only an indirect one, in that, water serves as a growth medium of algae

which in case of water use are responsible for day-time pH levels in the water high enough to facilitate a rapid conversion of NH_4^+ to NH_3 gas which volatilises⁴, thus bringing about a sharp concentration gradient between NH_4^+ in the soil and water. This in turn, however, has presumably responsible for diffusion of NH_4^+ -N from the soil to the irrigation or standing water. Similarly, uptake of nitrogen, was 65% higher in case of urea formaldehyde, 68% in case of saw-dust urea-form and 75% in case of SCU and BCUF in wheat. Uptake of nitrogen was little lower in rice than wheat. The trend of variations, however, was the same as that of wheat.

The authors are thankful to West Bengal Science and Technology Committee, W. B. Planning Board, Govt. of West Bengal for financial help. Thanks are also due to Jadavpur University and Prof. R. N. Mukherjee, Dept of Chemical Engineering, Jadavpur University.

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Regulatory effect of herbicides on the composition of tomato fruits

The widespread use of herbicides for the control of weeds has made an important contribution to agriculture¹. The plants are killed as a consequence of changes in their metabolic activity following herbicidal treatment. The effect of applied herbicides on the metabolism and composition of living

plants are complex indeed². Wort³ inferred that effects dependent on a changed water content may be the earliest visible symptoms of herbicides on a plant. The stimulation of plant growth and improvement of plant by subtoxic dosage of herbicides has been observed by several workers⁴⁻⁷. The target effect of these chemicals on weeds has been investigated, but the side-effect of these chemicals on the composition of tomato (*Lycopersicon esculentum* Mill) have not been studied. The present study was, therefore, taken up to have an idea about the influence of herbicides on the physico-chemical composition of tomato fruits.

A field study was conducted at the Vegetable Research Station of N. D. University of Agriculture and Technology, Kumarganj, Faizabad, using tomato variety HS-101 during 1986. Recommended fertilizer and irrigation practices were followed. The experiment was laid out in a randomized block-design with four replications. In all five treatments, comprising of five herbicides and their two combinations along with an untreated control, were tried. Fluchloralin (1.0 kg a.i./ha), paraquat (0.5 kg a.i./ha), pendimethalin (1.0 kg a.i./ha), thiobencarb (2.0 kg a.i./ha), methabenzthiazuron (1.4 kg a.i./ha), pendimethalin (0.5 kg a.i./ha + methabenzthiazuron 0.7 kg a.i./ha) and pendimethalin (0.5 kg a.i./ha + thiobencarb 1.0 kg a.i./ha) were used.

Fresh fruits were harvested to determine fruit weight, size, colour, moisture, protein, acidity, ascorbic acid, total carotenoids, lycopene content, reducing and total sugar content. Fruit weight was measured on a physical balance. Fruit size was determined by Vernier Callipers and its colour was observed by visual observations. Dry matter content was determined by oven-drying the samples at 65°C till constant weight. Protein, acidity and ascorbic acid content were analysed according to A. O. A. C.⁸ methods. Total carotenoids and lycopene content were estimated according to Ranganna⁹. Reducing and total sugars were

determined by Shaffer-Somogyi micro-method⁸.

Fruit weight and size increased significantly over control in most of the treatments (Table 1). The observations indicate that most of the treatments act as a growth

with the combined application of pendimethalin and thiobencarb. The observed increase in protein might be due to the favourable effect of these herbicides on nitrogen metabolism.

Reduction in total acidity content was

TABLE 1: Effect of different herbicides on physical parameters of tomato fruits

Herbicide	Weight (g)	Length (cm)	Diameter (cm)	Colour
Control	45.9	3.6	4.6	Pinkish yellow
Fluchloralin	48.0	3.7	4.8	Pink
Paraquat	46.6	3.6	4.7	Pink
Pendimethalin	51.5	4.2	4.9	Pink
Thiobencarb	50.5	3.7	4.6	Bright Pink
Methabenzthiazuron	56.6	3.9	4.7	Bright Pink
Pendimethalin + Methabenzthiazuron	48.2	3.9	4.9	Bright Pink
Pendimethalin + Thiobencarb	52.8	3.8	4.6	Pink
C. D. at 5%	1.2	0.2	0.01	

stimulator rather than a herbicide for tomato plants. An improvement in the colour of tomato fruits was observed by application of different herbicides. Similar results was also been obtained in other fruit crops^{10,11}. Application of herbicides significantly decreased the dry matter content over control (Table 2). Application of all herbicides enhanced the protein content and a significantly higher amount of protein was observed

observed due to the application of herbicides. It has been observed that respiration rate was enhanced by the application of herbicides^{12,13}, therefore, the loss in acidity may possibly be due to its utilization in respiration. An improvement in ascorbic acid content of tomato fruits was observed. The results indicated the influence of these chemicals on ascorbic acid biosynthesis. Total carotenoid and lycopene content, as affected by different

TABLE 2: Effect of different herbicides on biochemical parameters of tomato fruits

Herbicide	Dry matter (%)	Protein (%)	Acidity (%)	Ascorbic acid (mg/100g)	Total carotenoids (mg/100g)	Lycopene (mg/100g)	Reducing sugars (%)	Total sugars (%)
Control	15.25	1.22	1.22	23.86	11.41	1.78	1.79	4.85
Fluchloralin	14.00	1.90	0.82	28.22	11.74	2.04	1.90	4.76
Paraquat	14.00	2.16	0.96	25.42	12.55	2.21	1.63	4.58
Pendimethalin	13.50	2.00	0.91	26.17	11.92	2.22	1.68	4.69
Thiobencarb	15.60	1.80	1.15	24.13	12.44	2.25	1.54	4.68
Methabenzthiazuron	14.00	2.24	1.13	28.52	14.34	2.36	1.74	4.72
Pendimethalin + Methabenzthiazuron	13.00	1.80	1.14	25.08	14.55	2.86	1.51	4.48
Pendimethalin + Thiobencarb	12.00	2.30	1.17	26.28	14.82	3.05	1.39	4.45
C. D. at 5%	0.98	0.12	0.05	1.13	1.18	0.75	0.12	0.14

treatments, indicated a slight increase with the maximum amount obtained with the combined application of pendimethalin and thiobencarb. Reducing and total sugars revealed a marked reduction in these constituents due to herbicidal action. It may be due to greater utilization of carbohydrates by the treated plants and produced more energy and carbon sources for amino acids and protein synthesis. Similar results has been obtained in other crops^{11,14}.

It is concluded that herbicides, in addition to their weed-killing action have an additional effect in increasing the nutritional quality of a crop. To date it has not been possible to utilize this knowledge to form an agronomic practice, which could be effectively utilized in a food and protein-deficient world.

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Received : 22 December, 1986.

Revised : 31 March, 1987.

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Feulgen staining of DNA following treatment of acid hydrolysed tissue sections with different chemicals

It has been reported in an earlier publication¹ that there occurs marked increase in nuclear staining intensity following treatment of tissue sections, prior to acid hydrolysis, with different reagents, such as urea, tributylamine, *tris*-buffer, glycine, sodium nitrite and sodium hydroxide. This investigation was undertaken with a view to find out whether there is depletion or augmentation of nuclear colouration in acid hydrolysed tissue sections subjected to treatment in different organic chemicals, such as alcohols, ketones, ethers, phenol and pyridine as well as in three different inorganic ions, such as iodinated alcohol, gold chloride and chromic acid.

Feulgen reagent used in this investigation was prepared as follow : To 100 ml of warm distilled water was dissolved 500 mg of rosaniline (BDH, C. I. No. 42510). To this dye solution were added 1.0 g of potassium metabisulphite and 5 ml of N HCl. This reagent after shaking was kept at 5°C for 30 min and thereafter shaken vigorously with 1.0 g of activated charcoal and filtered. The filtrate was totally colourless and registered pH 2.0.

The tissue used had been pieces of liver of a white rat that were fixed in 10% neutral formalin. Paraffin section (8 μ m) were used.

Regular Feulgen staining was performed after acid hydrolysis of deparaffinised sections which were treated for 10 min in alcohols, such as methanol, ethanol and tert-butanol ; ketones, such as acetone and cyclohexanone ; ethers, such as solvent ether, anisole and diaxane and in conc. solution of phenol and pyridine. Post hydrolysis treatment of tissue sections was also performed in iodinated alcohol (prepared as 1.0 g of iodine along with

1.0 g of potassium iodine in 100 ml of 90% ethanol), in 2% aqueous solutions of each of gold chloride and chromic acid. Sections after post hydrolysis treatment were thoroughly rinsed in water for 1-2 min to remove the presence of the different chemicals. Staining with Feulgen reagent was then performed for 10 min at 35°C. Following staining, sections were rinsed in water, treated with 0.05 N HCl for 1-2 min, rinsed with water, dried between folds of filter paper, treated with n-Butanol for 1-2 min, cleared in xylene and mounted in DPX.

Microscopic examination of preparations that were subjected to treatment in the different chemicals following acid hydrolysis and brief rinsing in water were stained with Feulgen reagent revealing perfect nuclear colouration similar to that in the controls. Staining of sections after acid hydrolysis followed by treatment in iodinated alcohol revealed perfect colouration of the nuclei. On the contrary, post-hydrolysis treatment of sections with gold chloride and chromic acid when stained with Feulgen reagent revealed a rather less intense staining of the nuclei as compared with that of the controls. Moreover, similarly treated sections revealed an extremely feeble staining of the cytoplasm.

The above results suggest that DNA-aldehyde molecules are extremely stable and are not acted upon by chemicals like alcohols, ketones, ethers, phenol and pyridine. Since there is no loss of stain from the nuclei in sections post-treated with the above chemicals nor is there any marked increase in the intensity of nuclear colouration, the obvious conclusion is that DNA-aldehyde molecules are not soluble in the chemicals used in this investigation nor is there any possibility of their binding with the different organic compounds at least during the period of 10 min of treatment following acid hydrolysis.

It was reported in an earlier communication¹ that the absorption properties of the stained nuclei in tissue fixed in the different metal ions mixed with formalin are the same. In all cases, the peak-absorption maximum

was at 570 nm. In all these cases, of staining with Feulgen reagent, the intensity of nuclear colouration was the same in sections of tissues fixed in the different metal ion containing fixatives. Although no attempt was made to find out of absorption-peak in the present cases, it is possible that it may be the same as found in an earlier experiment¹. From the present study, it is also evident that treatment of sections after acid hydrolysis with iodinated alcohol, gold chloride and chromic acid followed by staining with the dye-reagent results in intensity of nuclear colouration being not much different from that of the controls. Thus it is clear that post-hydrolysis treatment of sections in iodine or gold or chromium do not have any deleterious action on DNA-aldehyde molecules in the tissue fixed in formalin. It is, however, to be noted that following treatment of sections after acid hydrolysis with chromic acid or gold chloride, sections must be thoroughly washed under running tap water for at least 2 min before being flooded with Feulgen reagent. Otherwise there is an extremely feeble staining of the cytoplasm, although the nuclei are clearly visible.

Finally it is concluded that DNA-aldehyde molecules liberated through acid hydrolysis are extremely stable and are not acted upon by the different chemicals used in this investigation, as judged by Feulgen staining.

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Received: 30 December, 1986.

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Record of walnut leaf miner *Rhynchaenus* sp. (Coleoptera : Curculionidae) from India

Walnut, *Juglans regia* L. is one of the most important dry fruits grown in Indian sub-continent especially in the foot hills of Himalays over an area of 5000 hectares

extending from Simla to Darjeeling. Out of the total production about 60 per cent comes from Jammu and Kashmir State. As many as thirty insects species has been reported to infest walnut of which Coleopterans rank the 'most serious ones'. This is supposed to constitute a major constraint in the production of this fruit on commercial scale.

During 1985 the preliminary survey for pest complex of walnut fruit trees, walnut leafminer *Rhynchaenus* sp. (Coleoptera: Curculionidae) was recorded as a serious pest infesting the leaves at the Horticultural farm, S. K. University of Agricultural Science and Technology, Shalimar. The observations were recorded at fortnightly interval and infested leaves counted upto the height of 2 meters. The grub was observed mining the anterior portion of the foliage resulting in the rolling of the tips. Maximum damage occurred from mid April to mid May. The infested leaves showed a characteristic mine made by the grub on the tip of the leaf. The fully grown grub is apodous, elastic, measures 4.2 mm to 5.0 in length and its head breadth measures at 0.32 mm. It is purple in colour and grows in the roll of mined leaf. The full grown adult is brownish black in colour, very active in habits and moves very fast. Adult *Rhynchaenus* sp. measures from 3.0 to 3.5 mm and 1.2 to 1.5 mm in length and breadth respectively.

In earlier studies¹⁻⁵ particularly dealing with genus reported causing damage to various plants, viz. *R. subgasciatus* Gyllenhal infest Oak leaves², whereas *R. ulni* L. causing serious damage to elm tree bark³.

A perusal of earlier literature indicate that *R. mangifera* Marshall infesting mango trees^{4,4a,5} and *R. fagi* L. a predominant insect inhabiting beech *Fagus sylvatica* L.⁶. Although Balc⁶ report *R. fagi* mining the

foliage of a wide range of plants hosts like beech oak, elm, haz el, willow and various conifers including pine and yew but so far *Rhynchaenus* species has not been recorded on walnut. Thus recent collection of this insect is interesting from the point of view since there is no record of *Rhynchaenus* sp. feeding on walnut from India. The present collection of this insect pest is an important addition to the insect pest found on walnut trees.

In view of the wider hosts range of *Rhynchaenus* sp. an outbreak of the pest is feared. As such further investigations are needed which would generate information on its bioecology, population, dynamics and about natural enemies of the pest to develop management strategy for the control, before it attains the status of a major pest in the walnut growing areas.

Authors are grateful to Director of Research and Extension Education, S. K. University of Sciences and Technology, Shalimar for providing necessary facilities to carry out the investigation.

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Received: 27 October, 1986.
Revised: 27 January, 1987.

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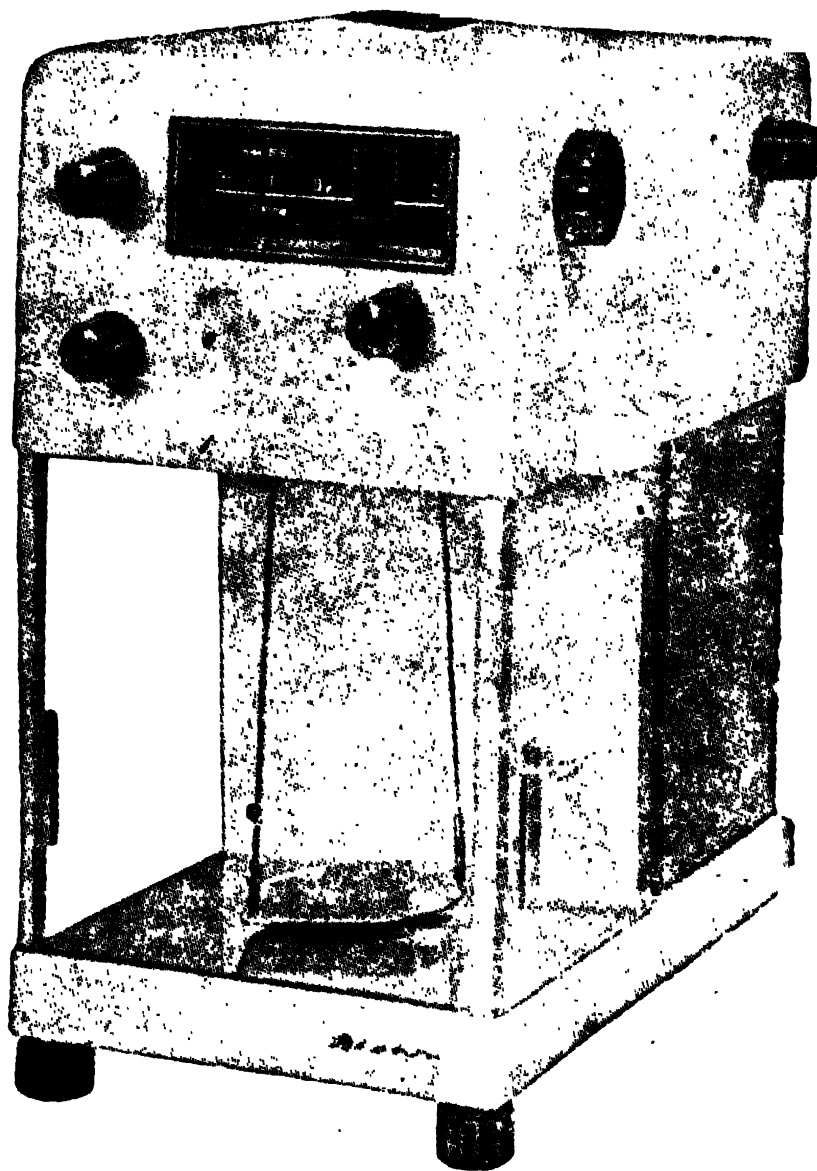
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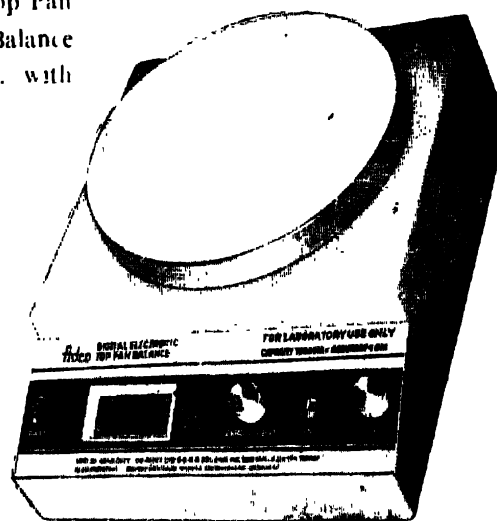
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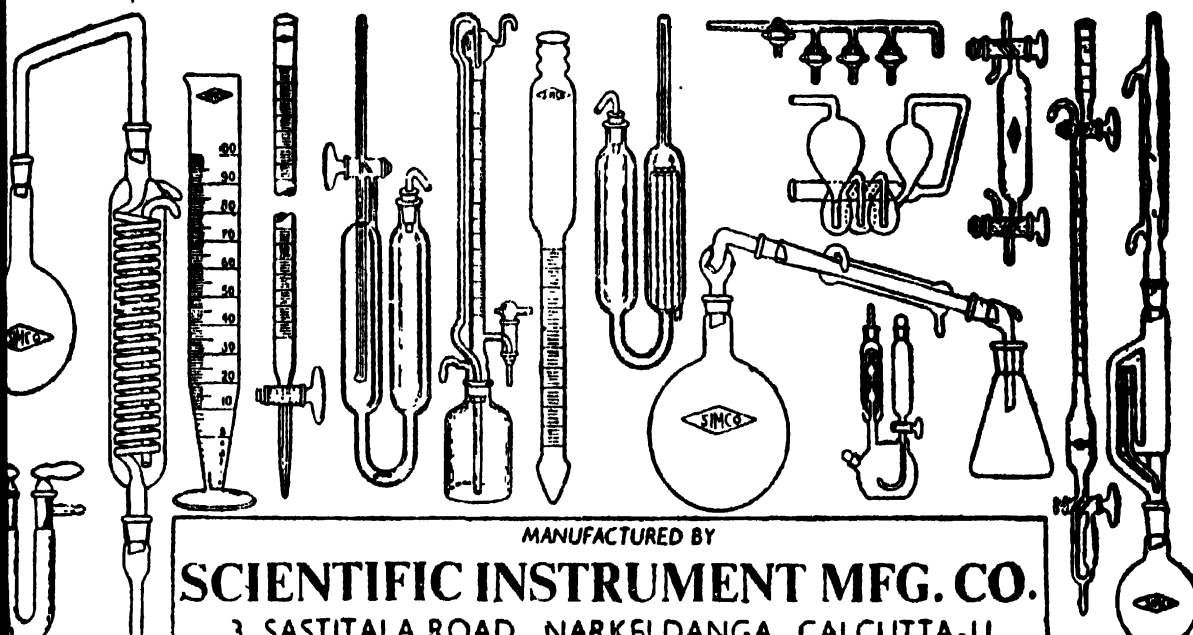
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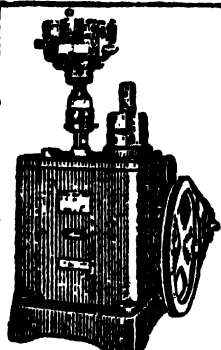

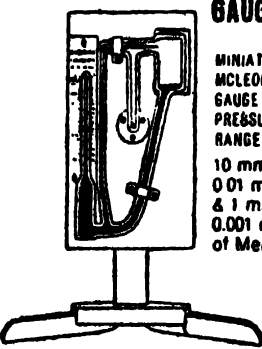

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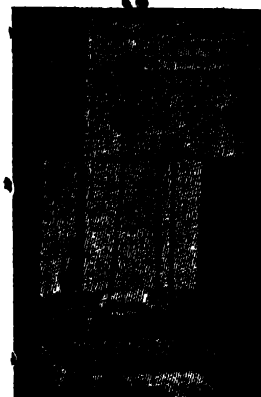
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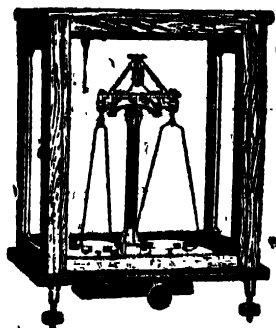


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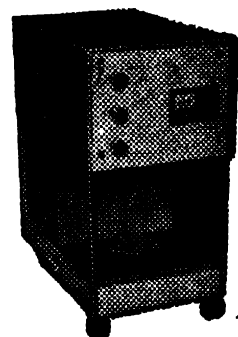
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ENVIRONMENTAL POLLUTION : A GLOBAL DILEMMA

G. K. SHARMA*

"The world is too much with us: late and soon
Getting and spending, we lay waste our powers :
Little we see in Nature that is ours
We have given our hearts away, a sordid boon !
This sea that bares her bosom to the moon ;
The winds that will be howling at all hours
And are upgathered now like sleeping flowers ;
For this, for everything, we are out of tune ;
It moves us not.—Great God ! I'd rather be
A Pagan suckled in a creed outworn.
So might I, standing on this pleasant lea,
Have glimpses that would make me less forlorn ;
Have sight of Proteus rising from the sea ;
Or hear old Triton blow his wreathed horn."

William Wordsworth

Beginning with the celestial Vedas to the present day, thinkers, seers, philosophers, and men of science alike have revered Nature for numerous reasons. In the centuries-old Rig-Veda, we find hymns emphasizing harmony and resonance with Nature. Environmental quality is a test of human morality and ingenuity. A civilization built on the destruction of natural balance and ecological devastation cannot be enduring.

Although it is easy to rationalize Thomas Huxley's cynicism, nay, pessimism enunciating man's brutality towards Nature, yet we must face the colossal problem of environmental degradation so evident today. This

managing problem is affecting both human health and vegetation—the very basis of food chain in our biosphere. This global phenomenon, if not understood, analyzed, and challenged, may devour human civilizations of today and the future.

The world-wide menace of environmental pollution is affecting the Taj Mahal, the Thames, and the Pyramids alike. It is feared that the Taj Mahal, glorified for its elegance and romantic connotations, may become a victim of the twentieth century demon—

Biology Department, University of Tennessee,
Martin, TN, USA 38238

environmental pollution and its affiliates! This historic monument, which has touched the nobler cords of human emotions for hundreds of years and challenged the bards to capitalize on its nascent beauty for the amelioration of human spirit, sits close to the ghost of the so-called "marble cancer".

Industrialized countries of North America and Europe, especially Western Europe, represent an extreme end of the spectrum. Despite the availability of technologies to correct the sad situation of environmental pollution, the process is slow, fraught with strong political and bureaucratic lobbies and pressures of industry, multinational corporation and vested individual interests. Hazardous chemical wastes, acid precipitation, sulphur dioxide, ozone, nitrogen dioxide, heavy metals, ozone and smog seem to top the long list of environmental pollutants saturating the biosphere in the industrial West. More than 60,000 chemical compounds, created by chemists, are on the market. In spite of their short-term and perhaps prolonged benefits in some cases, most present a ghastly view of the things to come. In addition, more are introduced into the system every year. Environmental Protection Agency, a regulatory agency of the United States, has publicly pointed out that almost half of these compounds are hazardous to living organisms. Almost 50% of the American population use ground water and this aquifer is constantly being contaminated by authorized and mostly unauthorized dumping of these dangerous chemicals into the main source of drinking water. There are more than 50,000 dumping areas in the United States where hazardous chemical wastes have been stored and some of these are terribly dangerous to human health and are believed to stay this way for centuries.

Reports of leaks and contamination of the environment by P. C. B., dioxin, radioactive waste, arsenic, etc. in a wide variety of places in the West are too frequent. Urban New York's Love Canal, Pennsylvania's Three

Mile Island and rural Missouri's fields represent examples of environmental contamination by these chemicals and nuclear material. EPA estimates indicate that the USA is producing 80 billion pounds of dangerous chemical wastes annually and only a small percentage are being disposed of in a safe manner. It might be relevant here to indicate that the innocent or perhaps naive countries of the Third World are also being used as dumping sites of hazardous wastes by the multinational corporations of the industrialized countries of the world. The sad tragedy brought about by the negligence of Union Carbide in Bhopal is a classic example of environmental terrorism caused by industrial arrogance. Hysteria generated by such episodes needs a reflective balm of explanation. Bhopal estuary and the Gulf of Cambay on the Indian subcontinent are some of the recent examples where aquatic pollution has been created by industrial wastes and the wildlife is in desperate condition.

This unscrupulous and thoughtless rape of the environment is full of potential hazards to both human beings and vegetation. Even from biological and evolutionary standpoint, man is not able to adapt to this abrupt flow of chemicals into his system. There is, therefore, an increase in the incidence of horrible diseases afflicting the physical and mental health of society in the western world where industry has gone out of control. Technological advances do emit a bright and scintillating glow which is like a double-edged weapon. In other words, if this weapon is not properly handled, it can create serious problems. These advances, no doubt, made positive contributions to medicine, agriculture and decent life-styles, but at the same time some very unpleasant problems have been created by these space-age technologies. One wonders about the animal instincts of humanity when these chemicals are used in modern warfare. A case in point is the use of dioxin-rich Agent Orange in the Viet Nam war to defoliate the lush forests of that coun-

try. Not only the foliage and the human populations on the ground were affected, but also the pilots who sprayed this chemical and hence had exposure to it. Victims of this chemical suffer from hideous afflictions both in the USA and Viet Nam—perhaps another form of nightmare after the nuclear holocaust in Hiroshima.

Dumping of hazardous waste materials has become so common in the USA that even chemicals of "lesser infamy" such as benzene, toluene, vinyl chloride and arsenic are suspects. These waste products seem to be getting into the ground water—a horrible thought, yet a fact of life in our modern "civilization." Preventive measures to check this phenomenon of environmental pollution are underway but the process is slow and in the meantime, human health is at stake and it may be wise to ponder a basic, simple question: are the comforts achieved by modern technology worth the price in the form of human health, mental and spiritual balance?

Acid rain is another monster created by man's handling of industry. Acid rain, mainly a mixture of sulphur dioxide and nitrogen oxides, is destroying the lakes, the forests, the wildlife and agricultural crops. West Germany's forests, especially the Black Forest are dying because of acid rain. West Germany, a major industrial giant of Europe, burns 3.5 million tons of coal annually and this gives off sulphur dioxide and nitrogen oxides. These pollutants have affected a large percentage of coniferous (76%) and deciduous (40%) plant species. These figures are increasing at an alarming rate. Canada's lakes are dying because of local and imported acid rain from the USA. The prevailing winds from the midwestern parts of USA bring components of acid rain to the eastern industrial part of Canada and the USA. A vast stretch of forest area extending from the north-eastern part to the south-eastern pine forest is showing signs of pollution sickness.

Acid rain is known to destroy not only the foliage but also the mycorrhiza and even the leaching of nutrients from the top soil. Gaseous pollutants can also enter leaves through tiny pores called stomata and destroy the cytoplasmic membranes and organelles so vital for the metabolism and survival of the plant. It seems quite obvious that the burning of high-sulphur coal for various industrial purposes is ringing the requiem for the vegetation of the world.

The industrial moghuls of the world have been oblivious or reluctant to start the clean-up job. Further procrastination may be too late to avert the worst of the damages and costs. It is unfortunate that there is not enough quantitative information on the amount of acid precipitation in the underdeveloped and developing countries of the world. Pollution statistics on acid precipitation are quite sophisticated in Europe and North America. However, it is not difficult to imagine what lies ahead in the less industrialized parts of the world, particularly when the trend is towards complete mechanization and industrialization.

Ozone, an oxidant of significance, is the byproduct of automobiles, although it is found in Nature in the upper atmosphere and filters out harmful ultraviolet radiation. PAN (peroxyacetylnitrate) is another oxidant of major importance. These oxidants are the products of hydrocarbons and oxides of nitrogen emitted into the environment by automobiles. Photochemical reactions, in the presence of sunlight, are known to convert emissions of automobiles into ozone, which is harmful not only to human health, but also is one of the main pollutants destroying vegetation including cultivated crops. Beans, corn, soybean, potato, tobacco, spinach, alfalfa, tomatoes and a host of other crops are affected by it. It destroys the permeability of cell membranes and inhibits enzymatic activities—thus leading to plant death. PAN is even more dangerous than ozone. Large cities with immense vehicular

traffic generate these oxidants and transfer them to rural areas where agricultural practices are adversely affected. Some estimates attribute 90% of damage to plants to ozone—a sobering thought for champions of that four-wheeled monster—the automobile!

It is well to remember that all pollutants have numerous implications in terms of damage and destruction to living organisms by making them more susceptible to pests and disease. Flourides, emitted by industry, are harmful to animals feeding on flouride-contaminated forage. Flourisis, a deadly disease of cattle, is caused by this pollutant.

Particulates have been present in natural environment for a long time. Natural dusts, fires, volcanic eruptions and salt sprays near marine habitats are some of the examples. However, man-made particulate matter has changed the situation dramatically in the last few decades. Particulate emissions from burning, industry, automobiles and other sources are recent entries into our ecosystem. Particulates are microscopic solid particles or liquid droplets exhibiting Brownian movement in the atmosphere and are capable of causing hazard to both humans and plants. Chemically, they can be classified as mainly sulphates, nitrates and hydrocarbons; they are particularly detrimental to human health when they are involved in atmospheric inversion. Hayfever, dermatitis, bronchitis, cancer of skin, allergies and an array of respiratory ailments are caused by these particulate emissions. Their adhesion to foliage triggers a series of harmful reactions, resulting in the death of plants. There is some evidence of the deleterious effect of particulate matter on climate.

Pesticides, especially persistent pesticides have been known to man for a long time. The use of arsenic as an insecticide was known 2,000 years ago. However, pesticides have created some serious environmental problems today. This global nightmare is

evident in both the developed and developing countries of the world. Chlorinated compounds such as DDT present a unique problem. This widely used pesticide, though banned in the developed parts of the world because of its deleterious effects on human health, is being dumped into poor, developing and underdeveloped countries of the world. DDT can spread by wind and water; it is known to be in existence in all parts of the world and all kinds of ecosystems. Once in a food chain, it can cause alarming problems for living organisms. Obviously, political and commercial interests are at play in this misadventure at the cost of human health and environmental hazards. The prophecies feared in the *Silent Spring* seem real and frightening. We must pause and re-evaluate our progress and priorities for the maintenance of our precious environment since our lives depend on it.

Alachlor, a popular soybean and corn herbicide in use for years, is now banned as a potential carcinogen. In addition, it is suspected of causing birth defects and genetic damage. It is unfortunate that in our rush and lust for commercialization and profiteering, we are poisoning our food chain leading to dreadful consequences. While the developed nations start and stop the use of such poisons, the underdeveloped or developing countries suffer in their poverty, helplessness and ignorance and remain victims of commercialization from within and without. In spite of persistent efforts to generate more and new pesticides, pests are becoming more resistant to chemicals. A comprehensive look at biological controls seems to be the need of the hour—a way out of the present pre-occupation with chemical pesticides.

'Indoor pollution' is a newly discovered phenomenon in the western world and is catching up fast in the modern life-styles of the developing world. Chemicals used in the construction of buildings and in modern daily life pose a deadly threat to human health. Improper ventilation, so charac-

teristic of modern buildings, leads to pollution of the air that we breathe. Benzene, formaldehyde, styrene, asbestos and plastics are some of the major pollutants in modern homes and buildings. They can be found in offices, kitchens, bathrooms, doorways and living rooms and in the things we use in daily life. Tobacco smoke claims lives throughout the world. Cancer, respiratory ailments, dermatitis, kidney and liver damage are some of the products of 'indoor pollution.' Surely, there is message in this paradoxical pandemonium of modern life: a message for simple and basic life-styles exemplified by Buddha, Thoreau and Gandhi, who demanded only the bare necessities from the bounties of Nature.

It is interesting to note that most of the man-made environmental pollution in the world is produced by Western Europe, North America and Japan—a mere 5% of the earth's surface! With this sobering perspective, there is a ray of optimism and hope for the countries where industrialization has not reached a maddening height yet. It is known that some sections of the developing countries are extremely industrialized and the pollution levels are high. India's example is a classic one: it is the 10th largest industrial country in the world with excellent technological and industrial infrastructure but most of these industries are confined to only certain urban sections of the country. Before this land of Tagore and Mahatma Gandhi follows the trodden path of the West and hence commits an environmental suicide, it might be well for the leaders of the country to remember the difference between technological progress and civilization. This great technological leap into progress or industrialization should be done with great care and caution without destroying the fragile ecological balance—the very fabric of human civilization. Short-term gains must not be emphasized at the cost of long-range effects on environment. Technological and industrial progress in the East

must not give rise to another Los Angeles or New York or Tokyo or London. Ecological consequences of industry must be taken into account.

Utilization of coal is the mainstay of energy in the blue prints of industrial plans for most developing countries. World deposits of coal are known to be fairly abundant. At the present rate of utilization, they should last for more than 200 years while petroleum reserves are supposed to dry up in 40-50 years. India's future industrial plans based on coal must be carefully executed, in view of the pollution created by this fossil fuel. The fossil fuel has created problems during the entire history of industrialization of the Western world. It is, therefore, imperative that corrective measures (e.g. scrubbers in industry, catalytic converters in automobiles etc.) be taken early in the process in the developing countries. Wind-generated energy, solar energy, hydropower and even biogas must be thoroughly exploited. While nuclear energy is a very sensitive area, its utilization needs extremely rigid safety measures to avoid contamination of the environment. The problem of nuclear waste or spent fuel disposal must be taken into account since it takes, as of the most recent estimates, 10,000 years for the radioactive waste to disintegrate to harmless levels. At times, it appears not worth the effort to go for nuclear energy in view of the deadly potentialities and implications associated with it for the present and future generations. Such problems are facing the industrialized nations of the world. Some are dumping in the oceans around the world, while others are finding safe havens in the naive Third World, or locally with great resistance from the public. The developing nations clamouring for indiscriminate industrialization must bear in mind that radioactive glow is the price to pay for the carelessly planned industrialization. Technology is available today to reduce the degree of environmental pollution and it must be used to correct the existing

excesses of ecological rape and to minimize the danger of environmental contamination in the newly conceived industrial adventures. Efficient use of energy must be a serious consideration. Recycling of certain natural resources is more common in the developing nations than in the West and this practice should be refined to give it a touch of sophistication and efficiency. Environmental pollution must be simply regarded as a cancerous affliction and, hence, it must be dealt with at an early stage. Once ecological systems are under abuse, a sequence of biological disasters follows: plant-destruction, crop damage, human suffering, climatic modifications and eventually economic crisis and social disintegration.

As of today, the USA has 10,000 metric tons of nuclear waste or spent fuel at various nuclear power plants and the figure is rising every year. Where to store this is a nefarious problem which the guardians of a nation must find hard to handle. Similar problems are bound to arise in the developing nations if they blindly imitate the Western technology or are attracted by the glitter or neon of modern industrial infrastructure.

As industrial progress around the world moves into full swing and pressure on earth's resources increases because of increasing populations, it is but natural that a re-evaluation of our demands on the earth's resources will be imperative. We simply cannot afford to have a perpetual increase in our demands on our environment even if there are new frontiers to be exploited in space, sea and on land. A careless exploitation of the wealth of the sea or outer space or even Antarctica by the rich and technologically advanced countries of the world is bound to have social, economic, political and even religious repercussions and, hence, a discomfiting turmoil. Furthermore, a widening of the gap existing between the affluent and the poverty-afflicted is not only inhuman but totally outrageous and potentially dangerous. If this planet is

to remain a hospitable site for human life, we must pause, think and re-evaluate our strategy of handling and exploiting the resources of the environment for the good of all travelling on this spaceship Earth.

Environmental pollution is an ecological nightmare. It is a monstrous problem, requiring basic understanding of physical and biological components of environmental complex. Furthermore, inter-relationships existing between plants, animals and environmental pollutants require ingenuity of numerous, varied scientific endeavours to decipher the functioning code of our enigmatic cosmos.

Japan is one of the very few industrialized countries known to have taken substantial steps to combat environmental pollution and, hence, make a cleaner and healthier country. Measures taken by the government and industry have been expensive but in the long-run, well worth the cost. Japan has reduced its pollution levels, thereby preserving its future natural resources.

Perhaps another lesson can be learned from the USSR where major steps have been taken to rectify the plunders and blunders of the past. Environmental pollution level in that country is much less than in Western Europe of the United States. Based on several international scientific reports, it seems that major industrial cities of the Soviet Union have the cleanest air of any such areas in the world. The problem of acid precipitation is said to be negligible. This record is quite impressive in view of the fact that the country is one of the most industrialized nations of the world and also known for making extensive use of its mineral resources. Public awareness of the role of environment in the quality of life and its strict enforcement must be the key ingredients for such a state of affairs. In addition, private ownership of industry obviously has no place in that country and, hence, no or little insatiable greed so typical of the multinational corporations. It is these privately-owned giants

which have, on numerous occasions, disregarded human values and natural resources for lurid greed and profit. A large portion of the Soviet budget is spent on the protection and preservation of the national environment and ecological interests and natural resources of the nation are considered as public assets.

The world is "enjoying" the fruits of Carboniferous Forest, which 350 million years ago laid the foundation of fossil fuel. The use of this enigmatic fruit seems to be forbidden beyond a point. Perhaps that crucial point has already been crossed. Ecological systems are fragile but do have a remarkable degree of elasticity and recuperative power. Air, water and soil conservation are musts for human health, nay survival. Properly handled, there should not be a conflict between conservation and industrialization. Improper manipulation, however, will bring more tragedies like the ones in Bhopal, India and Love Canal, New York. A balance must be struck between ecology and urbanization or industrialization. Predatory activities born of insatiable greed lead to water, soil and air contamination, floods, forest denudation and impairment of human health and, hence, these activities must be checked. This is a moment to pause and reflect! At this juncture, it may be fitting to quote the eternal wisdom of *Rig-Veda* :

"A steady Light, swifter than thought, is stationed among the moving things to show the way"

And let us resolve to decipher this Light and follow it before we lose resiliency.

Eastern culture and tradition for reverence of Nature must be revived to bring home the message that environment and its inhabitants are meant to live in harmony with each other if we are to maintain a steady, healthy lifestyle. Indian seers and ascetics of antiquity sang hymns of the beauty of Nature. Forests were their abode and rivers like the Ganga and the Yamuna had pure, life-giving nectar. The mythology has it that Lord Shiva spread his hair to act as forests for checking soil erosion! It is believed that the religion of the primitive inhabitants of the Mediterranean regions was the worship of Earth. Modern scientific analysis of the hidden message of these metaphors and deeper reflection of ancient Vedic concepts should be of great value in understanding the significance of ecological preservation.

Unfortunately, we are passing through difficult times. Denudation of forests is on the increase, wild-life is threatened, the great rivers are contaminated and the environmental pollution is spreading. There are reports of some multinational corporations of the Western World dumping their hazardous wastes in the developing countries of Africa, Asia and Latin America. Basically, relevant solutions geared towards local problems are needed. Countries, with rich cultural heritage and scientific ingenuity, must be able to articulate their scientific manpower to bridle this phenomenon of environmental pollution. Countries may be lost not only through conquest and invasion but also from within by ecological aggression and devastation. We must act now! □

MAN AND THE ENVIRONMENTAL RADIOACTIVITY

N. R. DAS*

HUMAN life, right from the very beginning of its existence on earth, has always been exposed to various ionising radiations from different natural sources like cosmic rays, radioactive substances occurring originally in the lithosphere or hydrosphere, etc. This radiological exposure is now becoming more and more intense with the development of modern nuclear technology which has a powerful impact on human society. The advent of nuclear bomb as well as the peaceful uses of radioactivity have raised many questions concerning worldwide environmental pollution from ionising radiations.

Our environment comprising the whole physical and biological systems in which man and other organisms live becomes contaminated or polluted by both natural and artificial radioactivities. Ionising radiations present in the domain of radioecology, that is the pathways of radionuclides from its point of release until it reaches man, in general, react with materials causing division of their atoms and molecules and also result in physico-chemical changes in the living tissues by interrupting or destroying the normal biological cell activities and eventually damage the whole system. The status of man's health represents the complex interaction between his biological system and the environmental conditions. In the present world where the radioactive substances and the radiation producing devices have become an essentially accepted elements of modern society, man through his own day-to-day activities plays a vital role in his own environment. Thus, the relation between

man and his environment may be depicted schematically as—

Source of Ionising Radiations

Most of the advanced countries have developed nuclear capabilities and nuclear reactors for the generation of electric power and have also devised nuclear fuel based submarines, space-crafts, ships, etc. Nuclear explosions which result from fission or from a combination of fusion fission processes produce tremendous amounts of heat instantaneously within small quantity of matter and form a mixture of various gases, melted nuclear fuels and some partially melted environmental materials. With gradual cooling of the fireballs, the melted materials solidify giving rise to debris. The word 'fall-out' which was coined in 1945 when the first atomic bomb was detonated at Alamogordo in New Mexico refers to this radioactive debris that is destined to fall back to the surface of the earth following any nuclear explosion. Thus the increasing sources of radiations used for peaceful purposes as well as the associated 'fall-out' from weapon testing will continue to increase the potential radiation to the general population and hence it is predicted that radioactivity will become a future source of environmental pollution of major concern.

The 'fall-out' consists of a mixture of about 200 radioactive fission products each with its characteristic radionuclidic prope-

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rties. Some of the important radionuclides present in the debris are listed in Table 1.

TABLE 1: Some of the important fission products in the debris produced by nuclear explosions

Fission Product	Half Life	Mode of Decay
$^{90}\text{Sr}_{38}$	52 d	β^- , γ
$^{90}\text{Sr}_{38}$	28.1 y	β^-
$^{95}\text{Zr}_{40}$	65 d	β^- , γ
$^{131}\text{I}_{53}$	8.1 d	β^- , γ
$^{131}\text{I}_{53}$	20.9 h	β^-
$^{137}\text{I}_{53}$	23 s	β^-
$^{137}\text{Cs}_{55}$	30.23 y	β^- , γ
$^{140}\text{Ba}_{56}$	12.8 d	β^- , γ

Since most of the nuclear weapon tests which add artificially produced radioactivities to the environment are carried out mainly in the Northern Hemisphere, the general concentration of radioactivity is much higher in this Hemisphere than that in the Southern Hemisphere. For example, the cumulative deposit of the radioisotope, ^{90}Sr , reaches 160 mCi per square mile in the Northern Hemisphere in contrast to the values one-fourth as great in the Southern Hemisphere. The nuclear cloud containing these radioactivities descends as total 'fall-out' in varying concentrations depending on the size of the particles and the air circulation patterns at various altitudes. Besides these sources of ionising radiations from nuclear weapon tests, artificially produced radionuclides have a wide variety of uses in different technological, radiological devices, power productions, extraction of radon from earth's surface and other investigations which expose people of modern civilisation to ionising radiation in excess of the natural background. At present, the highest doses received by population from unnatural sources is associated with medical treatment. The total natural background contribution from cosmic radiation, geological and other environmental radiation sources is found to be approximately 100-200 mrem Y^{-1} .

In addition to the radiological exposure of man to the artificial radioactive pollutants,

man is continuously exposed to radiations externally from cosmic rays and naturally occurring radioactive materials in the ground, air and in the structural conditions in which he lives and works and internally by naturally occurring radioactive substances in the human body, e.g., ^{90}Sr , in the bone. The principal sources of radiations from naturally occurring isotopes other than those of uranium, $^{238}\text{U}_{92}$, (end product, $^{206}\text{Pb}_{82}$, RaG), thorium, $^{232}\text{Th}_{90}$ (end product, $^{208}\text{Pb}_{82}$, ThD) and $^{235}\text{U}_{92}$ of the actinium series (end product, $^{207}\text{Pb}_{82}$, AcD) are cited in Table-2 with some

TABLE 2: Some important naturally occurring radionuclides with their characteristic nuclear properties

Radioactive Nuclide	Relative Isotopic Abundance, %	Half-Life in Year	Mode of Decay
$^{40}\text{K}_{19}$	0.00118	$1.28 \cdot 10^9$	β^- , EC, γ
$^{50}\text{V}_{23}$	0.24	$6 \cdot 10^{15}$	β^- , EC
$^{87}\text{Rb}_{37}$	27.85	$5 \cdot 10^{11}$	β^-
$^{115}\text{In}_{49}$	95.72	$6 \cdot 10^{14}$	β^-
$^{125}\text{Te}_{52}$	0.87	$1.2 \cdot 10^{13}$	EC
$^{138}\text{La}_{57}$	0.089	$2 \cdot 10^{11}$	β^- , EC, γ
$^{144}\text{Nd}_{60}$	23.85	$5 \cdot 10^{15}$	α
$^{147}\text{Sm}_{62}$	14.97	$1.1 \cdot 10^{11}$	α
$^{148}\text{Sm}_{62}$	11.24	$1.2 \cdot 10^{15}$	α
$^{152}\text{Gd}_{64}$	0.20	$1.1 \cdot 10^{14}$	α
$^{176}\text{Lu}_{71}$	2.59	$3 \cdot 10^{10}$	β^- , γ
$^{174}\text{Hf}_{72}$	0.18	$2 \cdot 10^{14}$	α
$^{187}\text{Re}_{75}$	62.93	$7 \cdot 10^{10}$	β^-
$^{190}\text{Pt}_{78}$	0.0127	$6 \cdot 10^{11}$	α

of their characteristic radioactive properties. The largest single natural radiation dose contribution comes from the ground itself upon we live. Amongst the naturally occurring radionuclides, $^{50}\text{V}_{23}$ is the nuclide of lowest elemental specific activity, 0.006 dpm g^{-1} , while the specific activities of $^{87}\text{Rb}_{37}$ and $^{187}\text{Re}_{75}$ are 5.4×10^4 dpm g^{-1} and 5.3×10^4 dpm g^{-1} respectively. Because of the presence of thorium and uranium minerals, an average background radiation dose level of 40 mrem Y^{-1} always exists on the surface of the earth.

The impact of primary and high energy

secondary cosmic rays near the top of the atmosphere produces many nuclear particles such as neutron, proton, α -particles, etc., which again react with the gases, e.g., N_2 , O_2 , Ar, etc., in the atmosphere to form radionuclides like $^{10}Be_4$, $^{14}C_6$, etc. in significant yields. These radionuclides come down to the earth with rain. Cosmic radiation varies somewhat with latitude and increases with altitude. At sea level, the average dose level is 30-40 mrem Y^{-1} , while at a level of 3000 m, the dose level increases to about 100-150 mrem Y^{-1} . Some of the radionuclides present in the cosmic rays are presented in Table 3.

TABLE 3 : Radionuclides formed in the atmosphere through cosmic ray irradiation

Radionuclide	Atmospheric production rate, Atoms $m^{-2} s^{-1}$	Half-Life	Mode of decay
3H_1	2500	12.35 Y	β^-
7Be_4	61	53.4 d	EC
$^{10}Be_4$	360	1.6×10^6 Y	β^-
$^{14}C_6$	22,000	5736 Y	β^-
$^{22}Na_{11}$	0.6	2.60 Y	β^- , γ
$^{36}Ar_{18}$	1.7	7.16×10^6 Y	β^- , EC, γ
$^{35}S_{16}$	14	87.5 d	β^-
$^{36}Cl_{17}$	11	3.0×10^5 Y	β^- , EC
$^{37}Cl_{17}$	16	56 m	β^- , γ

Pathways to Man

Radionuclides in the environment reach human population mainly through food following various alternative pathways. These pathways of the radionuclides vary depending on their characteristic properties and the circumstances of contamination. For example, radioisotopes in the atmosphere may be deposited directly on the surface of the plants, fruits or seeds that are taken up by man as food or may be washed down by rain to soil and enter into the plant through the roots along with other radioactive minerals present in the earth like soil nutrients in different extent. Man can also receive contamination by consumption of meat or animal and fisheries pro-

ducts. Radionuclides of strontium, ^{89}Sr (51 d), ^{90}Sr (28 y), cesium, ^{137}Cs (30 y) and iodine, ^{131}I (8.08 d), reach man primarily through the dairy products like milk and also through vegetable, etc. Again, carbon is an essential constituent of all living organisms. The radioisotope, ^{14}C (5800 y), which is being created constantly in the atmosphere by the action of cosmic radiation or by the neutron produced by nuclear explosions becomes incorporated in all living organisms with natural carbon dioxide through photosynthesis. Thus, pathways for radiation exposure for man may be external, internal or both. A schematic diagram for the pathways for radiological exposure of mankind is shown in Figure 1.

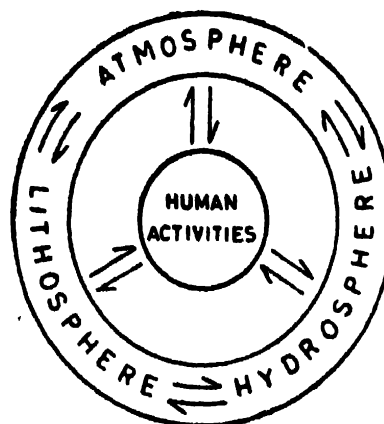


Fig. 1. Relation between man and environment

Biological Effects

The biological effects of radiations are brought out through chemical changes in the cells in the organs by ionisation, excitation dissociation and atom displacement. For any radiation,—neutron, α -particle, β -particle, X-ray or γ -radiation, the energy is dissipated through the biological systems in the same manner as in other materials resulting damage to the organs directly by disrupting the cells. The rate and the extent of biological damage due to ionising radiations depends on many parameters such as the type and energy of radiation, density of ionisation, dose rate, the organ exposed, the

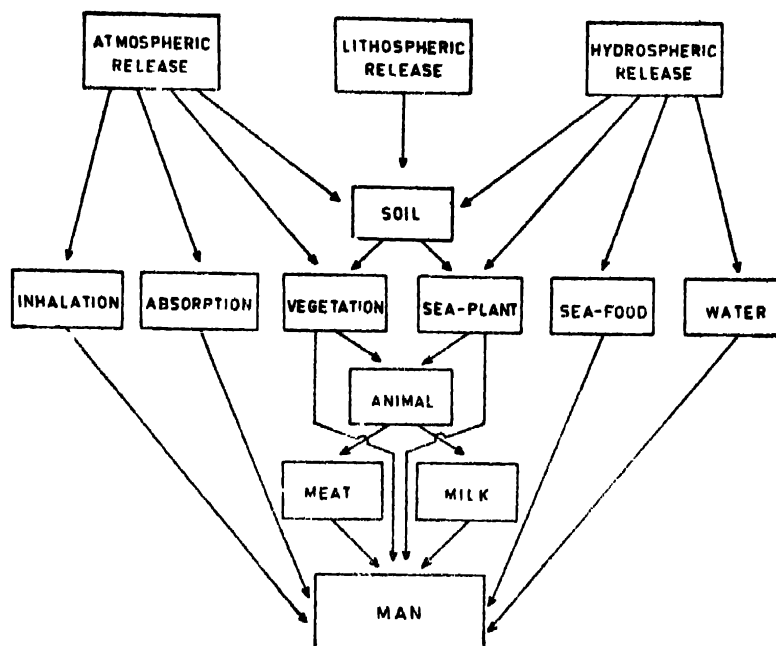


Fig 2 Pathways for radiological exposure to man

age, condition of health, excretion of radioactive materials and particularly, the pathways of radiological exposure both internally and externally.

As regards radioactivity, α - or β -particle with comparatively less penetrating power, cause localised ionisation and internally there are highly dangerous. The electromagnetic radiation, X- or γ -ray photons are, however, highly penetrating and can traverse the whole body and in general are very dangerous, both internally and externally. However, for internal exposure, α - and β -radiations because of their highly localised activities become more hazardous and can easily disrupt the DNA molecule whereas, in the same conditions, the photon may sometimes pass through the whole chromosomes containing about 10^9 molecules of DNA without causing any appreciable damage to it.

Regardless of the types of radiations, the human tissues are highly sensitive to ionising radiations, in general, and the radiation damage in biological cells is manifested in different ways. The reproductive organs,

the organs of the abdominal cavity, the blood producing cells of spleen and bone marrow, the tissues in various nervous systems, the skin, the eyes, etc., are very sensitive to ionising radiations. Radiations can effect directly the exposed individual or indirectly their descendants and these effects are broadly classified as :

(1) Somatic effect that occurs to the exposed individuals within his life span. Such effects may be manifested as in increase in cancer or bone tumours, induction of leukaemia, cataract formation, loss of hair, miscarriage or still-birth, shortening of life time, etc. There is a controversy as to whether somatic effects are threshold or non-threshold and

(2) Effects on offspring conceived after the exposure of individuals are called genetic. Ionising radiations have genetic consequences only in so far as they affect the reproduction cells ancestral to them in the reproduction organ (gonad). Any change in the mutation rate is considered to be harmful. Genetic effect shows a non-threshold behaviour that is, any dose radiation may be considered

minor, but can be delayed for generations.

The human body consists of about 60-70 per cent of water and hence it can be considered as aqueous solution for the cells prone to radiolysis. Consequently, on irradiation most of the energy will be deposited in water which becomes activated leading to the formation of some active species which then react with other materials present in the medium. In fact, the radiolysis of water yields primarily radical and molecular products as; H , OH , e_{aq} , H_2 , H_2O_2 , etc. The extent of yields of these species depends on linear energy transfer (LET) value of radiation. The disruption or aberration of the cells resulting biological damage in aqueous solution by radiological exposure are mainly due to the radiolytic products of water.

Radiation Dose

The biological effects of radiation are primarily related to the intensity of radiation as well as the time of exposure. In determining the radiation effect on living organisms whether it is from external radiation or from ingested or inhaled radioactive materials, one has to take into consideration not only the total amount of ionisation produced in the organisms but also the time of radiological exposures.

The quantity or the amount of radiation, although not measured directly, can be accounted by the ionisation produced by its passage through a medium. For measurement of radiation dose, several units related to the charge, energy or to the biological effects are in use.

The term, Rontgen (R), is applied only to electromagnetic radiations and is defined as that quantity of X- or γ -radiation that will produce 1 esu of charge, either -ve or +ve in cm^3 of air at standard temperature and pressure. This corresponds to 1.6×10^{12} ion pairs per gram of air.

The common unit of absorbed dose of

radiation is the Radiation Absorbed Dose (rad) which gives a measure of the absorbed energy of any type of ionising radiation in any medium. One rad represents an energy absorption of $10^{-2} \text{ J kg}^{-1}$ or 100 erg g^{-1} of tissue. Rontgen expresses the intensity of radiation field, that is, the exposure while the unit, rad, gives a measure of the absorbed dose by the medium.

However, the unit, Rontgen Equivalent Man (rem) which involves the biological effects, compensates for the differences for ionisation, energy transfer, etc., of a wide variety of radiations those may be encountered. The rem is the quantity of radiation of any type which produces the same biological effects in man as those resulting from the absorption of 1R of X-ray or γ -radiation.

Radiation effect is mainly related to genetic effects and therefore considered on the basis of the age. The total accumulation of amount of radiation at any age should not exceed the value obtained by the equation,

$$D = 5 (N - 18)$$

where D = radiation dose in rem and N = age of the exposed person in years. Thus, it is evident that it eliminates any person eighteen years of age or younger from International occupational exposure to radiation. Basically, the radiation limit should not exceed 1.25 rem per quarter of a year. The Maximum Permissible Level (MPL) for radiation dose recommended by the International Atomic Energy Agency is 0.1 rem per week.

The possible biological effect depends on the radiation dose actually delivered to a particular tissue since it is this dose which determines, in general, the extent of damage caused to a particular tissue. It may be mentioned, for example, that at a threshold value of 25 rem whole-body radiation (MPL), early somatic damage of blood change appears and at a dose level of 50 rem, decrease in the white blood counts take

place. Other biological changes are affected at radiation dose of approximately 200 rem. Some of the approximate threshold dose value for radiation damages are listed in Table 4.

TABLE 4 : Some threshold radiation dose values for radiation damages

Whole-body radiation dose in rem	Biological effects
25	Appearance of somatic effects
50	Decrease in white blood counts
200	Sp 50, sickness dose of 50% of those biologically affected
400	Lp 50 lethal dose of 50% of those biologically affected
600	Lethal dose, 100% fatal
750	Death due to gastrointestinal bleeding within several days
1000	Death due to destruction of neurological system within 24 hours

Different organs in the biological systems have got specific affinities for different elements and hence the biological damages caused by a radionuclide increase when a particular radioactive isotope is concentrated in a particular tissue. For example, ^{90}Sr deposits in the bone, ^{137}Cs concentrates in soft tissues, ^{131}I accumulates in the thyroid gland and so on. Some heavy elements like radium, plutonium are preferentially concentrated in the sensitive parts of bones resulting localised hazard by α -emission. Thus the permissible dose limits for different parts of human body vary and have realistically differentiated as shown in table 5.

TABLE 5 : Recommended maximum permissible level (MPL) for an individual adult

Organ	Occupational rem Y ⁻¹	workers rem per 13 weeks	Member of public, rem Y ⁻¹
Gonads, red bone marrow	5	3	0.5
Skin bone, thyroid	30	15	3.0
Hands, forearms, feet and ankles	75	38	7.5
Other organs (single)	15	8	1.5

The extent of biological damage due to ionising radiation can be minimised by using some biologically acceptable chemical reagents like nitrate, benzoic acid, propylamine, cysteine ($\text{HS.CH}_2\text{CH}(\text{NH}_2)\text{COOH}$) and thiols (RSH) as scavengers for hydroxy radicals formed as a radiolytic product in human system. The reagents react with the hydroxyl radical which is primarily responsible for biological effects resulting in the decrease of the effects of radiological exposure as a whole. However, the protective reagents are chemically toxic and can not be used frequently. The reagent, ethylenediamine tetra-acetic acid (EDTA) acts as an effective complexing agent, in general, for removal of radioactive materials incorporated in the body.

In spite of all these adverse effects, both somatic and genetic, of radiological exposure, one has to expose himself to the ionising radiations from artificial radioactivities more and more in the daily life in addition to that already existing in our natural environment. Industrial and scientific applications of the radioactive materials for the welfare of mankind have extended enormously in recent years. The cell damaging property of ionising radiations is fruitfully being applied in radiotherapy, food sterilisation, etc. X-rays or γ -rays can cause cancer as well as it cures cancer. Medical science is the single largest user of artificial radionuclides. In these respects, the discovery of radioactivity, if it is used only for the welfare of mankind, is rather a bliss than a curse.

Although, "the ionising radiations tell none of their presence", yet one should not be afraid of just it because of the presence of radioactivity in the environment. It may be mentioned that in certain areas in Kerala (India) and in Brazil, natural background radiation dose levels as high as about 1300 mrem Y⁻¹ and 12,000 mrem Y⁻¹ respectively are recorded, but no characteristic biological

effects due to the radiation, either somatic or genetic, has yet been reported by the people of these localities. However, increasing sources of ionising radiations used for various peaceful purposes as well as the 'fall-out' and also the natural radiological back-

ground will continue to increase the potential radioactivity to the environment. Thus, environmental pollution due to radioactivity is an inevitable outcome of our growing urbanised and industrialised world of modern civilization. □

Notes and news

Andaman pearls

Two main species of pearl-bearing oysters have been found during a preliminary survey in the Andamans, according to two scientists of the Central Agriculture Research Institute.

The inter-tidal reef flats abound in black-lip pearl oysters and though the golden-lip variety has not been found here, they are to be found in the Mergui Archipelago, the eastern boundary of the Andaman sea, the scientists Saundarajan and Dorairaj said in a joint paper recently published by the Andaman Science Association.

The survey also revealed that green mussels though occurring in small numbers in the Andaman Sea, are to be found in a sizeable number around Silpighat near Port Blair.

Edible oysters like *Crassostrea madrasensis* and *Saccostrea cucullata* are found in plenty in the inter-tidal regions of these islands. Oyster meat is popular amongst the settlers from Bengal and Nicobaree fishermen, the scientists said. □

The Statesman

Electricity from magnets

A prototype of a power plant, which will produce electricity better than conventional power systems, has been developed by

Branover at the Ben-Gurion University of the Negev, Beer-Sheva.

The new concept in generation electricity consists of a loop system in which a liquid metal alloy is expanded by heat and forced through a magnetic field to produce electricity. Besides being less expensive, the Branover system has no polluting effects on the environment. □

News from Israel

Synthesis of biologically active compounds

V. J. Patil, while working at the National Chemical Laboratory, Pune, carried out the synthesis of biologically active compounds from carbohydrates. He synthesised L-daunosamine, which is the glycosidic component of the anti-cancer antibiotics, daunomycin and adriamycin. A new synthesis of L-daunosamine was done, starting from commercially available D-glucosamine hydrochloride. Like-wise, the fluoro analog, 2-fluoro-L-daunosamine was also prepared to evaluate the effect of fluorine substituent for the enhanced antibiotic activity. Noglamecin, an anthracycline antibiotic with a C-glycoside component in its structure, was created via Grignard reaction from the sugar, uloses. □

CSIR News

Knowledge gap limits nutritional upgrading of traditional foods

As in many tropical and subtropical countries, sugarcane is of great significance

in Brazil. Though considered much more a cash crop than a food crop, it also represents, as the most common sweetener, a source of dietary energy. *Rapadura*, a traditional product made from sugarcane juice, is widely consumed especially in the north and northeast, where it is often the only source of energy that enables the very poor to perform their work during the most severe food shortages. The consumption of rapadura appears to increase as other foods become scarce. In the more developed southern States of Brazil, rapadura is consumed by people who immigrate from rural areas. However, as a consequence of adverse economic conditions, rapadura is currently being considered as a component of school-lunch programmes, even in southern States.

The primitive process of making rapadura—the crystallisation of sucrose from sugarcane juice—probably followed the sugarcane crop to Brazil. Similar products are produced and consumed in China, Vietnam, Philippines, Thailand, Indonesia and India. A great many countries are familiar with non-centrifugal sugar, used largely for local consumption.

The popularity of rapadura and products with similar energy properties has attracted the attention of researchers at the University of Sao Paulo by incorporating a protein component. The aim was to determine whether the enrichment of nutritionally poor regional foods may under some conditions have a more immediate effect on nutritional status provided that the intervention does not interfere with the dietary habits of individuals beyond a certain limit. The specific goal was to examine the possibility of soybean meal with rapadura or similar products in countries where both sugarcane and soybean are produced in order to improve the daily protein supply per caput. Sweetness would mask the taste of this extra component, avoiding any pronoun-

ced change in the taste of the product. Moreover, in Brazil, it is customary to incorporate coconut, groundnut, pumpkin and other foods into rapadura. The United Nations has been proposing the use of oil-seed meals as direct sources of protein in human diet for many years.

Rapadura compares favourably with purified sugar, since it contains 2-5% protein besides its content of sucrose (reaching about 65%) plus fructose, galactose, glucose, rhamnose and xylose in smaller amounts. Biotin, niacin, pantothenic acid, riboflavin and vitamin A are also found in this product, indicating that they can withstand the high temperatures developed during the processing of sugarcane juice. The minerals contain salts of calcium, iron, phosphorus, potassium and sodium. Steroids and lipids constitute 0.5% of the total solids.

The making of rapadura is a primitive process easily learned. It consists of boiling sugarcane juice repeatedly until evaporation of the water content allows the sucrose to crystallise. At this point, the heavy syrup is transferred to wooden moulds. During cooling, sucrose crystals mixed with other components of the juice begin to agglomerate, forming a solid piece which is then removed from the mould. After reaching the point of sugar crystallisation, increasing concentrations of soybean meal are added to the heavy syrup and mixed thoroughly before transfer to the moulds. This does not complicate the process except at higher concentrations of soybean meal, when the addition of sodium bicarbonate to the syrup became necessary. In order to test the taste and physical traits of the resulting products, 20-90% of soybean meal were incorporated. With higher concentrations of soybean meal, a greater change in taste from the original product is noted. The end-product also becomes proportionately less resistant to break and is less compact than rapadura.

Traditional rapadura is characterised by long shelf life, requiring no protection against contamination except under unusually humid conditions. With the addition of soybean meal, however, fungi and yeast contamination would eventually create a greater need for protection. Nevertheless, the product suggests an alternative way to

enrich diets particularly of undernourished children, to whom the sweetness of rapadura would appeal greatly. What is lacking now organised programmes to study both the feasibility of producing this or similar products in domestic and large-scale systems together with studies concerning the acceptability and preservation of products with varying concentrations of soybean meal. □

Ceres

Letters to the editor

Degradation of Carotene and Chlorophyll pigments during fermentation of leaf-extract

Mechanical fractionation of green foliage into fibrous feed and proteinaceous food has been advocated to overcome protein deficiency and malnutrition in developing countries^{1,2}. During fractionation, the green foliage is macerated and pressed. The pressed crop is used for ruminant feeding and released juice or leaf-extract to prepare food-grade leaf-protein concentrate (LPC). During the preparation of LPC, proteins in leaf-extract are coagulated by either acid or heat¹. Natural acidification of leaf-extract through anaerobic fermentation has also been recommended for this purpose³. Earlier investigation from this laboratory⁴ has reported considerable dry matter and protein loss during fermentation of leaf-extracts. This communication reports the degradation of β -carotene and chlorophyll contents during fermentation of leaf-extract from lucerne (*Medicago sativa* L.).

The crop was cultivated in the Marathwada University Botanical Garden, harvested at a pre-flowering stage, pulped⁵, pressed⁶ and leaf-extract was collected. On November 27, 1984 and January 18, 1985 leaf-extracts were kept for fermentation as described earlier¹ and the samples were collected periodically till 5th day of fermentation for chemical analysis. The pH was measured, using glass electrodes. Dry matter (DM) content was determined by drying samples at 56°C till constant weight. Procedures outlined by Knuckles *et al.*⁷ and Yoshida *et al.*⁸ were followed for the estimation of β -carotene and total chlorophyll contents respectively.

TABLE 1: Degradation of carotene and chlorophyll during fermentation of lucerne leaf-extract (Pooled data of two experiments)

Day of fermentation	pH	% dry matter (DM)	β -carotene (mg/g DM)	Chlorophyll (mg/g DM)
0	5.68	10.7	1.62	6.82
1	5.45	9.8	1.30	6.63
2	5.38	9.8	1.28	5.51
3	5.07	9.6	1.21	5.50
4	4.90	9.5	1.21	4.65
5	4.75	9.4	1.13	4.15

Table 1 indicates that fermentation lowered the pH of leaf-extract with decrease

in dry matter (DM) content and degradation of β -carotene (provitamin A) and chlorophyll pigments. About 30% of β -carotene and 40% of total chlorophyll in the extract was lost during fermentation. Earlier study⁴ has reported DM and protein loss due to fermentation of leaf-extracts which resulted in poor yields of leaf protein concentrate (LPC). In view of these losses, the technique of fermentation may be employed to prepare LPC, along with the use of additives and after critical investigations.

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Received : 19 January, 1987.

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Physiological and biochemical control of glycoside formation in *Digitalis purpurea* with special reference to gibberellic acid treatment

Digitalis purpurea L. was first introduced in India as an ornamental plant but being of considerable medicinal importance, it

was successfully grown on experimental scale. So far various attempts have been made to cultivate this crop in India¹⁻³ but successful large-scale cultivation has not been established due to lack of processing facilities and limited demand. Evans⁴ estimated relative rates of biosynthesis of cardenolides and sapogenin steroids of *D. purpurea* by their uptake of ¹⁴CO₂. The sapogenins were produced more rapidly than the cardenolides at the stage of plant development. The growth and development studies on the plant are very limited⁵⁻⁸ and the present study is an attempt to deal with the control of vegetative and reproductive growth and improvement of glycoside biogenesis by gibberellic acid treatment. In addition to this, a correlative study of glycoside formation with other biochemical fractions has also been undertaken.

Seeds of *D. purpurea* were sown during November. Potted seedlings of (35 days old) were used as experimental material and were fed with gibberellic acid (GA₃) of different concentrations, i.e. 25 and 200 ppm. The feeding was done during morning hours through leaves followed by covering the plants by polythene bags for one hour. Each plant was fed with thirty ml of the solution.

Extension growth, formation of rosette (R-leaf), axial leaf (A-leaf), flower and fruit were recorded according to the method described by Nandi⁹. The total glycoside (TG) content as well as total nitrogen (TN) content of R-leaf were extracted and estimated following the method of AOAC¹⁰ and of Vogel¹¹ respectively. The reducing (R-CHO) and non-reducing (NR-CHO) sugar were extracted and estimated according to the method described by Bernfeld¹². The percentage increase or decrease during 15 days active period of three developmental stages

i.e. vegetative, reproductive and post-reproductive¹⁸ over control were analysed.

TABLE 1 : Effect of GA₃ on pattern of changes of functional parameters during three developmental stages of *D. purpurea*

Parameter	Percentage increase (+) or decrease (-) over control (%) during 15 days active period		
	Vegetative	Reproductive	Post-reproductive
25 ppm GA₃			
R-leaf formation	- 8.22	0	0
A-leaf formation	0	+ 156.25	- 22.39
Extension growth	0	+ 134.10	+ 10.12
Flower formation	0	+ 62.19	+ 1.32
Fruit formation	0	+ 51.15	+ 3.69
TG formation	+ 4.02	+ 5.36	- 1.67
200 ppm GA₃			
R-leaf formation	- 14.31	0	0
A-leaf formation	0	+ 183.74	- 26.81
Extension growth	0	+ 201.61	+ 15.22
Flower formation	0	+ 130.48	+ 14.26
Fruit formation	0	+ 109.33	+ 12.75
TG formation	+ 8.33	+ 11.15	- 2.81

Table 1 shows that glycoside content increase due to application of GA₃ during R-leaf formation. It is to be noted that with the increase of TG content during reproductive stage of development, the rates of extension growth, A-leaf, flower and fruit formation increase; maximum increase being noted in 200 ppm GA₃ treatment. Thus during reproductive stage, a positive correlation between the rates of increase of extension

TABLE 2 : Pattern of changes of biochemical fractions during three developmental stages in GA₃ treated *D. purpurea* plants

Parameter	Percentage increase (+) or decrease (-) over control (%) during 15 days active period		
	Vegetative	Reproductive	Post-reproductive
25 ppm GA₃			
TN	+ 2.56	- 1.68	+ 0.81
R-CHO	+ 1.39	+ 2.55	- 0.90
NR-CHO	+ 0.82	- 2.19	+ 1.31
TG	+ 4.02	+ 5.36	- 1.67
200 ppm GA₃			
TN	+ 3.01	- 2.11	+ 1.07
R-CHO	+ 4.20	+ 5.35	- 2.68
NR-CHO	+ 1.19	- 3.67	+ 2.42
TG	+ 8.63	+ 11.15	- 2.81

growth, A-leaf formation, flower and fruit formation and of formation of TG could be shown. During post-reproductive stage of development, rates of TG formation decrease.

Table 2 incorporates the pattern of changes of biochemical fractions in *D. purpurea* plants treated with GA₃. GA₃ treatment increased all the biochemical fractions during vegetative stage. During reproductive stage, TN and NR-CHO decreased which was accompanied by an increase of R-CHO and TG. The effects were more pronounced in higher concentration of GA₃.

The effect of GA₃ on the synthesis of active principles have studied by different authors¹⁴⁻¹⁶ and in this study GA₃ application also augmented the synthesis TG in *D. purpurea*. Treatments with GA₃ also increased A-leaf formation, extension growth and total number of flowers/fruits and these affects were increasingly pronounced with the increase of GA₃ concentration. An interesting pattern of glycoside synthesis was revealed in relation to progress of developmental growth and their control by GA₃ treatment. It is noted that TN and NR-CHO contents gradually increase within vegetative stage and thereafter declined, R-CHO increased till the reproductive stage. The increase of R-CHO could be said to remain associated with increased synthesis of glycoside. It might be indicated that TN and NR-CHO contents during vegetative stage could primarily remain associated with increased growth efficiency till termination of the said stage. It has been reported in literature that synthesis of glycoside in plants takes place by the participation of derivatives of carbohydrates from the leaves and ammonia via the roots. According to Pridham¹⁷, certain compounds like sugars and amino acids are capable of being translocated into the site of active principle synthesis. It might be said that increasing accumulation of R-CHO, mainly derived from accumulating photosynthates, could serve as one of the ingra-

dients to be channelled into the formation of glycosides in this study.

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Received : 27 January, 1987.

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Response of *Sitophilus oryzae* Linn. to extracts of *Adhatoda vasica* Nees

Adhatoda vasica Nees is an important medicinal plant¹ belonging to the family Acanthaceae. No information is avoidable regarding the anti-feedant action of this plant,

although extracts of *A. vasica* has been reported to have insecticidal activity against storage pests^{2,3}. However, the possibility of using extracts of *A. vasica* as wide-range agrochemicals has not properly explored. The present work is a part of such an exploratory programme.

A. vasica was collected from Midnapore district of West Bengal. The leaves of this plant after sun-drying were powdered by a plant grinder. About 3 kg of powdered plants were extracted with petrol-ether (b.p. 66-80°C) by soxhleting for 30 hr. The defatted plant was extracted again with methanol by Soxhlet for 16 hr. The crude extracts were obtained after complete removal of solvents from each extracts. Five and 2.5% solutions of both pet-ether extract and the chloroform soluble fraction of the crude methanol extract were subjected to entomological screening tests against adult rice weevil *Sitophilus oryzae* (Linn) (Coleoptera : Curculionidae), reared on wheat grains.

For studying the insecticidal properties, 0.4 ml of each of the extract at two concentrations was poured in clean, grease-free glass tubes of 50 ml capacity and uniform film of the extract on the inner wall of the vials were ensured by carefully rolling the vials containing solutions of the extracts and thereby allowing the solvents to evaporate. Fifteen freshly emerged adults were then released in each of the treated vials and open mouth secured to prevent escape of the adult. Such vials containing test insects were kept inverted to ensure through contact of the insects with extracts as the insect always tend to move upwards. For studying anti-feedant principles, 0.34 ml of each of the extracts at two concentrations was poured in glass vials of equal volume containing 20 sound grains of wheat and the solvents were allowed to evaporate completely before release of five freshly emerged adults of each of the sexes in each of such vials with treated grain to note the anti-

feedant activities of the extracts. Smearing the inner walls of the vials and soaking of sound grains and untreated vials and grains served as check. Observations on the mortality of the insects after contact of 24 hr and recording of number of grains fed at definite interval after exposures were recorded, and the results were based on three replications.

of food up to 5th day of treatment at 5% concentration of both the extracts. The anti-feedant effect lingered up to 1 day (by pet-ether extract) and 3 day (by methanol extract) on grains treated with 2.5% concentration. In solvent (chloroform)-treated and untreated control, 40% and 41% food damaged were recorded respectively

TABLE 1 Mortality of adults of *Sitophilus oryzae* at different duration after exposure to extracts

Extract	Concentration (%)	Mortality (%)				
		1st day	2nd day	3rd day	4th day	5th day
Pet-ether extract	5	13.33	20.00	23.33	33.33	40.00
	2.5	3.33	6.66	23.33	33.33	36.66
Methanol extract	5	23.33	26.66	33.33	40.00	43.33
	2.5	13.33	20.00	33.33	43.33	50.00

Insecticidal tests showed that both the concentrations of the two extracts (pet-ether and methanol) were effective to give about 40% (by pet-ether extract and 50% (by methanol extract) mortality of the adults of *S. oryzae* within 5th day after treatment (Table 1). Furthermore, lower dose was more effective and showed some

during this period.

The results of the present investigation indicate that the extracts of *A. vasica* were positively toxic on contact and strong anti-feedant to adults of *S. oryzae*. Hence, *A. vasica* could be exploited for the development of naturally occurring agrochemicals.

TABLE 2 : Extent of feeding by adults of *Sitophilus oryzae* on treated grains

Extract	Concentration (%)	Food damaged (%)				
		1st day	2nd day	3rd day	4th day	5th day
Pet-ether extract	5	—	—	—	—	—
	2.5	—	3.33	5.00	10.00	16.66
Methanol extract	5	—	—	—	—	—
	2.5	—	—	—	1.66	6.66
Control (Solvent-treated)		20.00	28.33	30.00	33.33	40.00
Control (Without any treatment)		18.33	26.66	30.00	35.00	41.66

delayed effect. During this period, there was no mortality of the insect in solvent (chloroform) treated and untreated check.

Both the extracts (pet-ether and methanol) at two concentrations also proved strong anti-feedant activity to the adults of *S. oryzae* (Table 2). There was no acceptance

The authors are indebted to the ICAR, New Delhi, for financial assistance through an adhoc project to Prof. N. Adityachaudhury, Professor of Agricultural Chemistry, BCKV. Grateful thanks are due to Dr. M. R. Ghosh, Reader, Department of Agricultural Entomology, BCKV, for supervising the entomological

part of the work and also the Heads, Department of Agricultural Entomology and Department of Agricultural Chemistry and Soil Science, BCKV, for providing research facilities.

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Buffering capacity of pressed-crop residues left after leaf-protein extraction

Silage is a product formed when green plant material is fermented in the absence of air. The process of silage making is known as ensiling. A good quality of silage¹, suitable for ruminant feeding, is produced when sufficient amount of lactic acid is formed to decrease the pH within a range of 3.8 to 4.2. However, in some crops the quantities of protein and calcium are often high. These constituents behave as buffers and neutralise the lactic acid produced during ensiling². This results in silage with relatively high pH and poor nutritive value. Earlier investigations^{3, 4} have shown that pressed crop residues, left after leaf protein extraction, make better silage with rapid drop in pH. The present investigation was undertaken with fresh and pressed crop materials wherein buffering capacity to lactic acid was measured.

TABLE 1 : Dry matter and protein content and their lactate buffer capacity of foliage from 12 species and

Crop	% Dry matter (DM)		Crude protein (% of DM)		Lactate buffering Capacity (mg/g DM)	
	Fresh crop	Pressed crop	Fresh crop	Pressed crop	Fresh crop	Pressed crop
Cowpea	14.8	30.0	21.9	13.5	75.6	42.0
Mung	14.0	27.6	19.6	14.4	69.9	34.9
Amaranthus	14.0	26.6	9.1	8.1	41.6	23.3
Broad bean	14.5	31.8	9.4	8.3	50.0	30.8
Spinach	8.1	23.4	15.6	8.8	26.6	16.7
Jowar	13.6	27.4	9.4	7.5	35.8	18.3
Maize	12.1	21.7	11.4	10.9	50.4	28.6
Wheat	14.4	27.2	18.8	11.3	31.6	15.8
Berseem	12.6	25.5	18.1	11.8	58.3	30.5
Bajra	14.1	29.5	15.0	12.1	33.3	29.1
Lucerne	18.8	30.2	13.5	14.8	66.6	50.0
Napier grass	25.5	30.5	8.1	6.8	70.4	45.9
Mean	14.7	27.6	14.6	10.7	50.8	30.5
Standard deviation	3.9	2.9	4.6	4.4	16.5	8.2
t value	9.28**		2.11		3.99	

Twelve plant species viz. Cowpea [*Vigna unguiculata* (L.) walp], mung (*Vigna radiata* Wilczek), Amaranthus (*Amaranthus paniculatus* L.), broad bean (*Vicia faba* L.), spinach (*Spinacia oleracea* L.), Jowar [*Sorghum bicolour* (L.) Moench], maize (*Zea mays* L.), wheat (*Triticum aestivum* L.), berseem (*Trifolium alexandrinum* L.), bajra (*Pennisetum typhoides* Rich), lucerne (*Medicago sativa* L.) and Napier bajra (*Pennisetum purpureum* L.) were cultivated in Marathwada University Botanical garden during 1983-1985. The cultural practices adopted for raising these crops were as per the recommendations. The crops were harvested for green foliage at a preflowering stage, pulped⁵ and pressed⁶ for leaf protein extraction. Samples of fresh and pressed crops were dried in an oven at $65 \pm 5^\circ\text{C}$, ground to a fine powder and taken for analysis. Nitrogen (N) content was determined by microKjeldahl method and crude protein (CP) was expressed as $\text{N} \times 6.25$. Measurement of buffering capacity to lactic acid (LBC) was made following McDonald and Henderson¹.

Data on dry matter (DM), crude protein (CP) and lactate buffer capacity (LBC) for fresh and pressed foliages are presented in table 1. In almost all species, pressed crop was with increased DM and decreased CP content. This was due to the removal of moisture and protein from fresh crop during pressing. On an average, DM increased from 14.7 to 27.6% and CP content decreased from 14.6 to 10.7%.

With the decrease in protein content, buffering capacity (LBC) subsequently decreased in pressed crop residues. The value of LBC indicates mg lactic acid required to lower the acidity of 1 g dried herbage sample to pH 4. The LBC for fresh crop ranged from 26.6 to 75.6, while that for the pressed crop from 15.8 to 50.0%. Decrease in LBC due to the pressing may be attributed to the removal of proteins and other buffering constituents during pressing. Nilson⁷ established a relation-

ship between crude protein content and lactate buffer capacity. During the present investigation a positive correlation ($r=0.506$) between protein content and LBC was noticed which was significant at 5% level. Thus, the removal of protein from green foliage makes it suitable for silage making due to low buffering capacity.

The authors acknowledge financial support by University Grants Commission, New Delhi.

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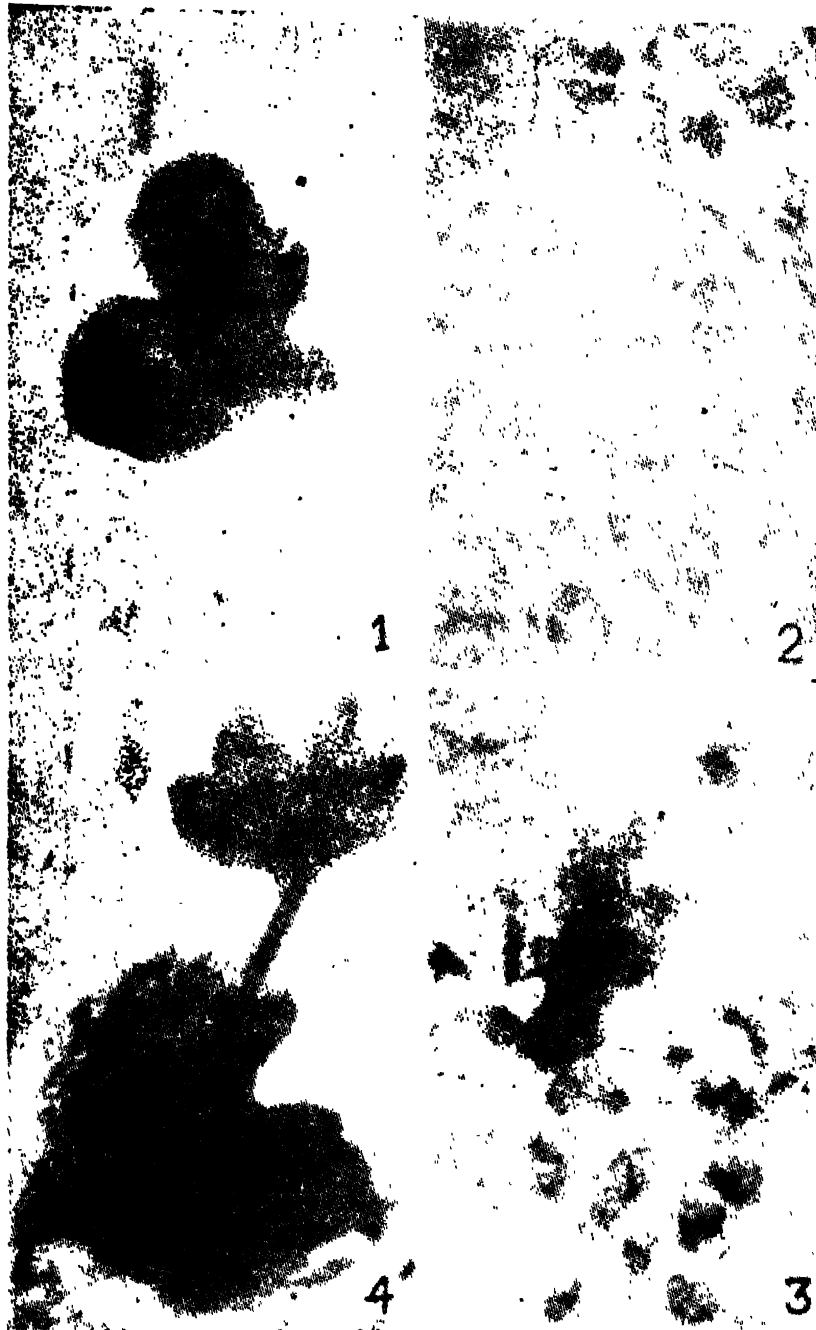
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Breeding system in *Diplazium esculentum* (Retz.) Sw

The gametophyte represents the sexual phase of the life of a fern. It is free-living, autotrophic and small enough to be cultured in number *in vitro* and examined under microscope. Gametangial differentiation in them is sequential, which largely determines their mating system. Thus, observations on the growth and differentiation of the gametophyte from spore germination to emergence of sporophyte have been made to reveal the predominant mating system in *Diplazium esculentum* growing wild in the locality of Darbhanga District, North-East Bihar. The



Figs. 1-4. (*Diplazium esculentum*) : (1) Normal mature cordate gametophyte 10 \times ; (2) Antheridia showing antherozoids 800 \times ; (3) Gametophyte with archegonia 80 \times ; (4) Gametophyte with sporophyte 10 \times .

TABLE 1 : Sex ratio in composite culture of *D. esculentum*

Days after sowing	Sample size	Sterile	Male	Female	Hermaphrodite
28	25	25	—	—	—
30	25	25	—	—	—
35	25	25	—	—	—
40	25	25	—	—	—
46	25	—	20	4	1
48	25	—	11	12	2
50	25	—	8	18	9

spores, collected from single and different sporophytes, were sterilized with 2% sodium hypochlorite solution, washed and sown uniformly on 40 ml of autoclave sterilized (15 lb/in²) inorganic nutrient media¹ (pH 5.5 maintained at 22±2°C under continuous white fluorescent light of 2500 lux intensity in a culture room. Prior to the initiation of gametangia, 28-day old cordate gametophytes were randomly isolated into four sets of population, viz. (a) 16 isolated gametophytes, in different petriplates (from single sporophyte); (b) 12 pairs of gametophytes (each petriplates containing one sib pair) ; (c) 12 cross culture of gametophytes (each petriplates containing one non-sib pair) ; (d) mixed culture of several petriplates (each petriplates containing 25 random gametophytes). These gametophytes were allowed to grow until they attained sexual maturity, where after fertilization was ensured by flooding them with a film of water more than once. Appropriate tests indicated the absence of apogamy in the population under investigation.

The spores germinated in 6 days, showing 100% germinability. Mature prothalli were bilobed which bore antheridia in 41 days

followed by archegonia in another 4 days of sowing (Table 1, Figs. 1-3). The frequency of sporophyte production was highest in mixed (95.9%), less in non-sib pairs (83.3%), lesser in sib pairs (66.6%) and least in isolates (12.5%) which indicated that *D. esculentum* has taken to cross-breeding due to accumulation of recessive sporophytic lethals in its gene pool in the absence of incompatibility barrier^{2,3}. The emergence of first sporophytic leaf started in mixed culture after 57 days of sowing (Fig. 4) was followed by those in cross (non-sibs) and pair (sibs) and lastly in isolate cultures. It may be noted that isolated cultures has less capacity of producing sporophyte by intra-gametophytic selfing and, therefore, encouraged intergametophytic selfing. This tendency of leaning towards cross breeding (Table 2) could be the reason of its inadequate distribution. Less intragametophytic selfing disqualifies a species plant from being an aggressive colonizer.

According to Klekowski⁴ and Lloyd⁵, the pattern of gametangial ontogeny from male to hermaphrodite confers some probability of intragametophytic selfing. The present study

TABLE 2: Breeding test for hybridization of *D. esculentum*, sporophyte formation in isolate, pair, cross and mixed culture

Sex expression	Population	No. of gametophytes studied	No. of gametophytes producing sporophytes	% Gametophyte producing sporophytes
Male to hermaphrodite	Isolate (16 gametophytes)	16	2	12.5%
	Pairs (24 gametophytes)	24	5 × 2 = 10	66.6%
	two sibs gametophyte per petriplate		6 × 1 = 6	
	Cross (24 gametophytes)	24	6 × 2 = 12	83.3%
	two non-sibs gametophyte per petriplate		8 × 1 = 8	
	Mixed (245 gametophytes)	345	331	95.9%

on *D. esculentum*, however, deviated from this assumption. Here the same ontogenic pattern strongly favoured inter-gametophytic selfing. One factor which can negatively affect this probability was the presence of recessive gene combinations which can be lethal in homozygous condition and thus prevent zygote formation following self-fertilization.

Hence, it can be concluded that *D. esculentum* cannot be primarily colonizer due to its genepool being surcharged by mutational load. High genetic load of a species would restrict its distribution as a result of which populations will cease to appear in continuity despite favourable edaphic factors.

The senior author is thankful to C.S.I.R., New Delhi for financial assistance.

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Antholysis in *Fagonia cretica* Linn.

Fagonia cretica Linn. (Family Zygophyllaceae), a characteristic plant of the Indian arid zone, is a short erect spiny undershrub with slender branches, terete, striates, glabrous or sparsely glandular-puberulous, growing

almost throughout the year. A distinct abnormality in the habit and the floral parts was noted in this species in the middle of June, 1986 at Jodhpur, which appeared similar to antholysis reported earlier.¹⁻³ The specimens showed virescence, i.e. turning of violet-coloured flowers into completely green ones. Typical observations were as follows:

(1) Infected plants were condensed, had a stunted growth and showed the absence of coloured flowers.

(2) In infected plants, the leaves became smaller and yellowish: chlorophyll *a*, *b* and carotenoids decreased in infected leaves (Table 1).

(3) Mucilage of the plants, when crushed with water, was found to be extremely low in comparison with normal ones.

(4) Flower number was less in infected plants. Colour of the flowers changed from violet to green.

(5) Size of pedicel, calyx and corolla increased more than the normal and the corolla changed to a rotate type (Fig. 1).

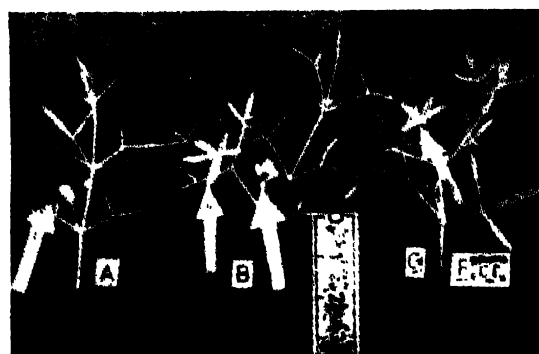


Fig. 1. Normal (healthy) branch (A) and infected branch (B & C) of *F. cretica*. Arrows indicate the flowers.

TABLE 1 : Chlorophylls *a*, *b*, total chlorophyll and carotenoids (mg/gm fresh weight) in infected and healthy leaves of *F. cretica*

Plant material	Chlorophylls			
			Total	Carotenoids
Infected leaf	0.505 ± 0.12	0.293 ± 0.063	0.798 ± 0.184	0.192 ± 0.05
Normal leaf	0.806 ± 0.003	0.483 ± 0.02	1.277 ± 0.029	0.304 ± 0.003

(5) Stamens were mostly shrivelled and anthers sterile without pollen-grains.

(7) Size of ovary increased and became flattened, while that of style decreased. The ovary then became leaf-like and was ultimately converted to a leafy branch (Fig. 1).

A similar condition has already been observed in *Sesamum indicum*¹, *Pedaliumpurex*² and *Convolvulus microphyllus*³. The infection on *F. cretica* which may be due to mycoplasma, as Sen *et al*¹, assumed it to be due to a mycoplasma-like organism causing antholysis.

Thanks are due to Head of Botany Department for providing facilities and DOEn for financial assistance in the form of a research project.

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A novel form of soybean inoculant

Carriers for the production of legume inoculants are usually in the form of powdered organic materials like peat¹, cellulose powder², lignite³, charcoal⁴, bagasse⁵, etc. Presently granular⁶, liquid⁷, and polyacrylamide gel⁸ forms are also used with success. In the present communication, the results of a study on an inoculant in paste form using celite (kieselguhr, a diatomaceous earth) as absorbent of rhizobial cells combined with protectant like liquid paraffin oil, is being reported.

Rhizobium japonicum, strain TAL 102, obtained through the courtesy of NifTAL project,

University of Hawaii, USA, was grown in yeast extract mannitol medium, while shaking continuously on a rotary shaker for five days at 28 to 30°C, to obtain broth cultures. A mixed charcoal soil (1:1) carrier⁹ was used to prepare the standard inoculant using the above rhizobial broth. For preparation of celite based inoculant, the following method was used : To 100 ml of culture broth, 20 g of powdered celite, particle size 20-45 μ (sterilized earlier by an autoclave) and 3 ml of liquid paraffin oil (sterilized by heat) were added and shaken on a rotary shaker for 5 minutes. This mixture was then filtered through double layered whatman filter paper No. 1 (sterilized by heat) under aseptic conditions. The sediment was then mixed thoroughly with 12 ml of liquid paraffin oil to make into a paste with sterile glass rod and filled into 30 ml previously sterilized screw capped tubes and stored at room temperature (28 to 33°C). At monthly intervals, the number of viable cells were monitored in both types of inoculants and also tested in pot culture experiments with sterile soil and separately in the field under rainfed conditions applying the inoculants at ten times the recommended rate¹⁰ on the seeds of the soybean variety, Pusa-16.

The results (Tables 1 & 2) showed that the celite based inoculant compared well with the conventional charcoal plus soil based inoculant, in survival, nodulation and effectivity. It is well known that diato-

TABLE 1 : Survival of *R. japonicum* (TAL 102) in different inoculants stored at room temperature (28-33°C) for 3 months

Survival of <i>R. japonicum</i> in percent (Mean of two replicates)				
Inoculant	Initial	1 month	2 months	3 months
1. Charcoal plus soil	100	82	25	32
2. Celite plus oil	100		25	40

TABLE 2: The effect of different inoculants on soybean variety, Pusa-16, in pot and field experiment

Treatment	Pot culture experiment (Replicates two— two months old)		Field experiment (Replicates four)	
	Number of nodules per plant	Dry weight of shoot per plant (g)	Number of Bean nodules per plant (two mon- ths old)	Bean yield (10 plants in g)
Uninoculated	0	0.72	0	12.1
Charcoal plus soil	15	1.00	1	13.2
Celite plus oil	23	1.12	6	20.5
C. D. at 5% [±]		N.S.		6.7

maceous earth like celite has an excellent absorptive as well as thermal insulating properties. It is also known that rhizobial cultures are being maintained with lasting viability under liquid paraffin oil. These attributes may explain the observed superiority of celite-paraffin based inoculant under rainfed field conditions. Another advantage of the product may be that it could easily be filled in collapsible plastic tubes for delivery and supply.

The author thanks Dr. N. S. Subba Rao, former Head, Division of Microbiology, I.A.R.I., New Delhi, for critically going through the manuscript and Dr. T. S. Raman, Division of Biochemistry for valuable discussions.

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Levels of some mineral elements in human head hairs of Dehra Dun

Determination of trace elements in biological samples is of great importance to nutritionists, medical practitioners, and veterinarians because of their prominent role in human nutrition, various diseases and toxicology. A lot of works has been carried out on human and animal hair sampling and analysis ¹⁻¹². The object of the present work is to determine the levels of various mineral elements in human head hairs of Dehra Dun and to study the effects of age and sex on the concentration of few elements.

From June, 1985 to August, 1985, 63 hair samples were collected from different localities of Dehra Dun. Samples were first washed with petroleum ether (80-100°C), followed by double washing with diethyl ether. 1 g of dry sample was boiled in dilute nitric acid (3:1) for 15-20 minutes; cooled and diluted to 50 ml with distilled water. It was filtered and the clear filtrate was analysed for Ca, Mg, Na, K, Cu, Mn, Pb, Fe, Zn, Ni, Co, Cd, Cr, Mo, V and Li with the help of atomic absorption spectrophotometer (Make-Pye Unicam SP 2900).

All the samples were divided into ten groups depending upon age. Ranges of different elements are listed in Table 1. It is clear from the results that there is a definite trend in hair mineralization of Dehra Dun. Concentration of various

TABLE 1 : Ranges of micro and macro elements in human head hairs of Dehra Dun

Sl. No.	ge No.	Macro Elements (ppm)										Micro Elements (ppm)						
		No. of Yrs. spls.	Ca	Mg.	K	Na	Cu	Mn	Pb	Fe	Zn	Ni	Co	Cd	Cr	Mo	V	Li
1.	5-10	6	1250-3164	180-742	317-1229	435-2251	7-9	2-4	2-22	21-39	162-220	5-7	0-2	0-3	0	0	0	0
2.	11-15	5	1016-2200	191-319	528-845	1101-1821	6-10	1-3	9-26	22-40	167-175	4-5	0-2	0-6	0	0	0	0
3.	16-20	5	2383-4141	262-746	163-481	372-1452	6-9	2-8	0-28	22-52	117-208	0-5	0-2	0-5	0	0	0	0
4.	21-25	7	1484-3164	228-798	144-594	372-748	7-12	2-11	7-20	16-95	142-158	2-7	1-2	0-3	0	0	0	0
5.	26-30	8	1094-3555	104-515	250-710	729-1280	4-13	1-13	0-44	21-65	133-175	0-3	0-1	0-0	0	0	0	0
6.	31-35	10	1406-2724	131-707	278-1095	502-1168	2-14	0-12	0-58	8-88	100-416	2-10	0-2	0-3	0	0	0	0
7.	36-40	5	1211-8133	180-963	237-461	461-895	4-10	2-3	0-4	16-109	108-383	0-8	0-2	0-0	0	0	0	0
8.	41-50	5	1564-1914	186-322	173-519	550-1182	6-13	2-3	4-22	23-41	120-150	2-3	1-2	0-3	0	0	0	0
9.	51-60	6	1210-1914	135-385	259-999	860-1970	7-11	2-11	0-11	41-70	154-175	1-6	0-1	0-5	0	0	0	0
10.	61-70	6	508-772	96-140	280-345	502-802	9-10	1-4	9-15	21-50	105-171	0-2	0-1	0-0	0	0	0	0

TABLE 2 : Comparison of macro elements in male and female head hair samples

Sl. No.	Age (Yrs)	Sex	Elements (ppm)			
			Ca	Mg	K	Na
1.	10	M	2500	319	403	478
		F	3164	742	317	435
2.	16	M	1016	319	528	1101
		F	4141	746	481	1452
3.	25	M	2188	328	173	748
		F	3164	798	144	396
4.	40	M	2200	201	480	560
		F	3020	415	370	490

elements cannot be directly connected with the age factor. Calcium and magnesium were maximum in the age group of 36-40 years, whereas potassium and sodium were maximum in the age group of 5-10 years. Lead and zinc were highest in the age group of 31-35 years and iron in the age group of 36-40 years. Copper was generally ranging between 2-14 ppm, manganese between 0-13 ppm, and nickel between 0-10 ppm. Lithium, chromium, molybdenum and vanadium were found to be totally absent in the samples analysed, whereas traces of cadmium and cobalt were noted only in a few samples.

In Table 2, comparison has been made between macro-elements of male and female samples of same age. It is observed that calcium and magnesium are generally more in female samples than male samples, whereas the case is reverse for sodium and potassium, except for the age group 16, where sodium shows much greater concentration in female.

I am greatly thankful to my Director, Dr. S. C. D. Sah for permitting me to carry out the present work. Thanks are to Dr. Rathi, Mr. Rawat, and Mr. Sharma for encouragement throughout the work. My sincere thanks are to all the donors of the hair samples.

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Effect of gamma rays on sex expression and yield in *Cucumis pubescens* Willd.

In monoecious plants like cucurbits the sex expression is modified by environmental conditions such as temperature, chemical vernalisation, radiations and hormones. Gibberellins and auxins are known to induce male and female sex expression respectively. In the present case a study was undertaken to see the effect of gamma rays on *Cucumis pubescens* Willd.

Materials and methods : Dry seeds of *C. pubescens* Willd, were irradiated with Co⁶⁰ source at the Department of Genetics, Osmania University, Hyderabad. The doses administered were 10kR, 15kR, 20kR, 40kR and 60kR.

Results and discussion : From the data in Table 1 it is observed that there was progressive increase in the length of vine up to 20kR and at higher doses it showed a decline. A delay in production of male and female flowers was observed in all the treatments.

TABLE 1 : Effect of gamma rays on *Cucumis pubescens* Willd.

Character	Control	Treatment				
		10kR	15kR	20kR	40kR	60kR
Vine length (cms)	97.00±1.28	97.80±0.62	121.60±0.33**	159.33±4.58**	129.06±0.33**	96.00±1.22
No. of lateral branches	6.40±0.49	4.12±0.54**	6.18±0.58	6.93±0.50	7.23±1.55	8.92±1.05*
Days taken to produce first male flower	33.00±3.00**	59.00±2.00**	40.00±2.00**	42.00±3.00**	65.00±3.00**	65.00±2.00**
Days taken to produce first female flower	39.00±2.00	60.00±4.00**	53.00±3.00**	58.00±3.00**	49.00±1.00**	49.00±1.00**
Total No. of male flowers	549	540	753	717	698	573
Total No. of female flowers	9	8	12	15	20	25
Sex ratio	61 : 1	67.5 : 1	62.75 : 1	47.8 : 1	34.9 : 1	22.9 : 1
No. of fruits/plant	9.41±0.37	9.00±0.25	10.00±0.21	10.00±0.35	8.00±0.42	24.09±0.21**
Yield/plant (grms)	587	522	640	666	683	1072
Pollen fertility %	95	84	80	78	65	58
Total yield (kg)	7.684	6.402	7.048	8.205	8.200	11.800

*t test—**Significant at 1% level

*Significant at 5% level

An interesting finding here was that in the control and in the lower doses i.e. up to 20kR the first male flower appeared earlier than the first female flower, but at higher doses a reverse situation was observed. There was not much difference in the sex ratio was observed. The number of fruits per plant and yield was maximum at 60kR treatment.

Stimulation of plant growth by ionising radiation at lower doses has been reported by many workers.^{1-3,6,7} The inhibition at higher doses may be due to damage of nuclei by high energy radiation⁴ and can also be attributed basically to the genetic loss due to chromosomal aberrations. The decrease in vine length noted at higher doses in the present study are in accordance with observations of the above workers.

According to Kuzin *et al.*⁸, irradiation probably acts as a trigger which induces synthesis of auxins, gibberellins, kinetins and flowering hormones, which in turn induce development of dormant growth points. With the increase in the growth points the generative organs also increase. The same may be true for the increased number of lateral branches observed at higher doses. In the present investigation greater production of female flowers was observed at higher doses, this could be due to the production of more number of lateral branches. The lateral branches are having a high tendency to produce female flowers^{9, 10}. It was also observed that at higher doses the first lateral branch appeared and produced female flowers earlier than the first male flower.

The shift in the sex ratio observed at higher doses is not due to decrease in the number of male flowers but due to increase

in the number of female flowers. This observation falls in line with that of Thakare and Bora in *Citrullus vulgaris*.

It can therefore be concluded that the increased yield observed at higher doses of irradiation is due to production of more number of lateral branches leading to the production of increased number of female flowers and fruits.

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Efficacy of synthetic pyrethroids in the management of *Heliothis armigera* (Hubner)

The gram pod borer, *Heliothis armigera* (Hubner) is a polyphagous pest known to cause damage to gram, red gram, pea, cotton, tobacco, tomato, sorghum, etc., but its most preferred host is gram, *Cicer arletinum* L., 50-100 percent loss in yield under natural pest attack conditions is in record⁴. The efficacy of several dust and spray formulations has earlier been reported⁴⁻⁶. A number of synthetic pyrethroids has been tried by several workers¹⁻³ against *H. armigera* on cotton. But there has been no such reports on the use of synthetic pyrethroids in gram. Considering the importance and scanty information on the use of synthetic pyrethroids, the present study was undertaken.

A field trial was conducted during rabi 1984-85 at Indo-German-Research and Extension Project, Sub-Centre, Pipariya. The experiment was laid out in randomized block design with three replications. The cultivar 'Ujjain-21' was used. The first spray/dust made at 50 percent of flowering of the crop and another spray/dust at 15 days after first spraying/dusting. The control plots were sprayed with water only. Five plants were taken at random from each plot at harvest and total number of pods and infested pods were recorded and percentage pod borer damage was calculated. The data on percentage were analysed after angular transformation. The grain yield was also recorded and analysed.

The results are depicted in table 1. Decamethrin had least damage (3.38%) which was at par with flucythrinate and fenvalerate. They were followed by cypermethrin and flurolinate. Untreated check had highest damage (15.26%) Decamethrin proved significantly superior in yield over all the treatments. It was followed by flucythrinate, fenvalerate and cypermethrin,

TABLE 1 : Effect of different insecticides on pod damage by *Heliothis armigera* H. and yield

Insecticide	Dose	Pod damage (%)	Yield (Q./ha)
Decamethrin 2.8EC	0.00325	3.38 (10.61)*	26.90
Flucythrinate 30EC	0.0136	4.18 (11.73)	17.90
Fenvalerate 20EC	0.0136	4.22 (11.84)	17.66
Cypermethrin 10EC	0.017	5.77 (13.87)	17.14
Flurolinate 25EC	0.0136	7.35 (15.71)	15.52
Monocrotophos 40EC	0.04	8.75 (17.15)	15.04
Endosulfan 35EC	0.07	8.92 (17.35)	15.14
Quinalphos 25EC	0.05	9.27 (17.71)	14.76
Parathion 2% dust 25 kg/ha		9.97 (18.36)	14.14
Untreated check		15.26 (23.00)	12.47
SEM ±		0.7182	0.590
C.D. at 5%		2.134	1.740

*Figures in parentheses are angular transformed values.

which were at par. Untreated check gave least yield which was at par with parathion dust.

From the above results it may be concluded that synthetic pyrethroids are more effective against *H. armigera* than synthetic pyrethroids.

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Received : 27 April, 1987.

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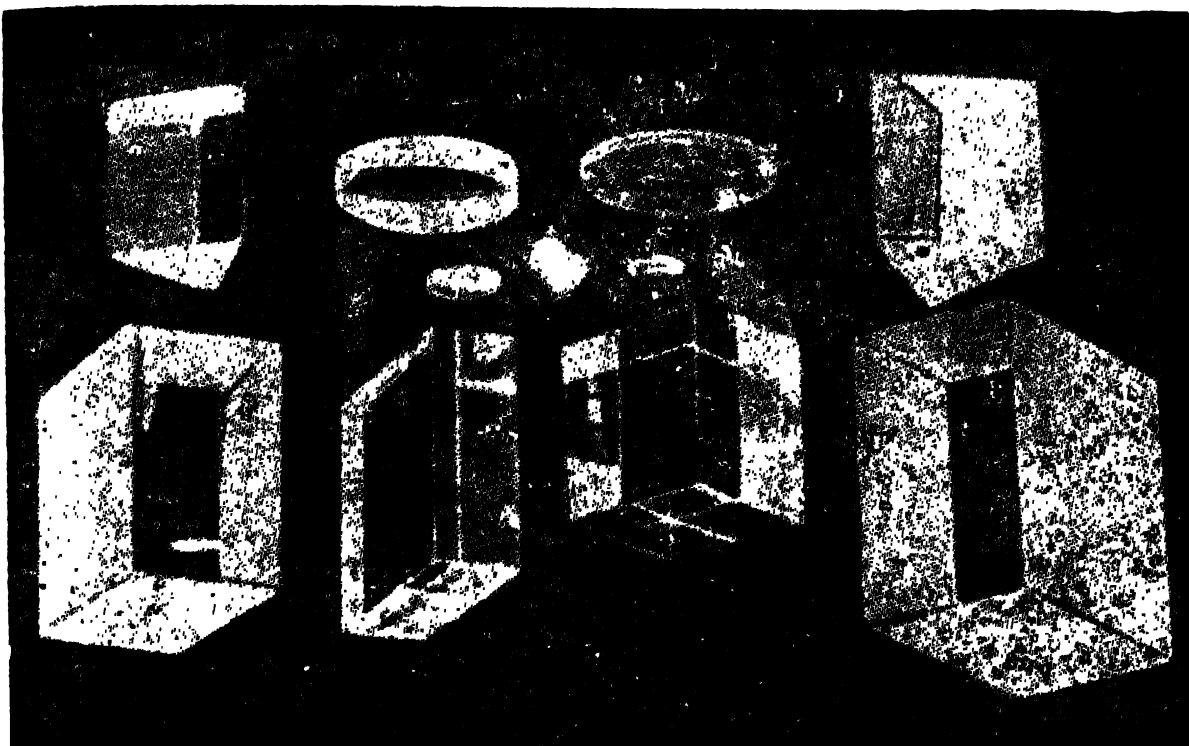
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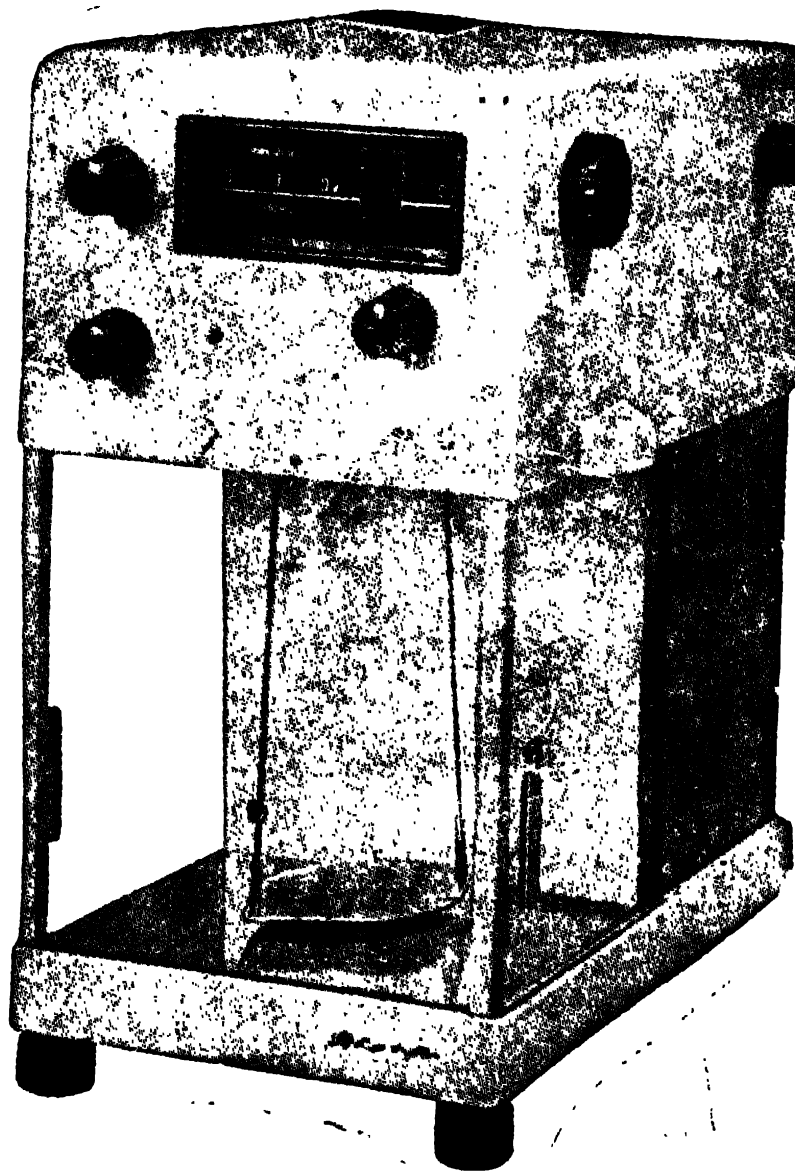
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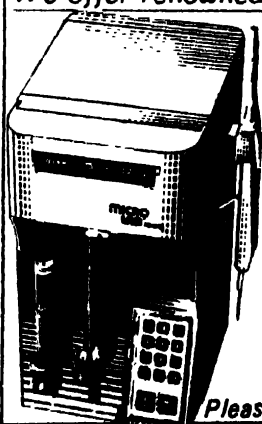
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(i) R. B. Walton and H. B. Woodruff, *R. Clin. Inst.*, 82, 924, 1949.

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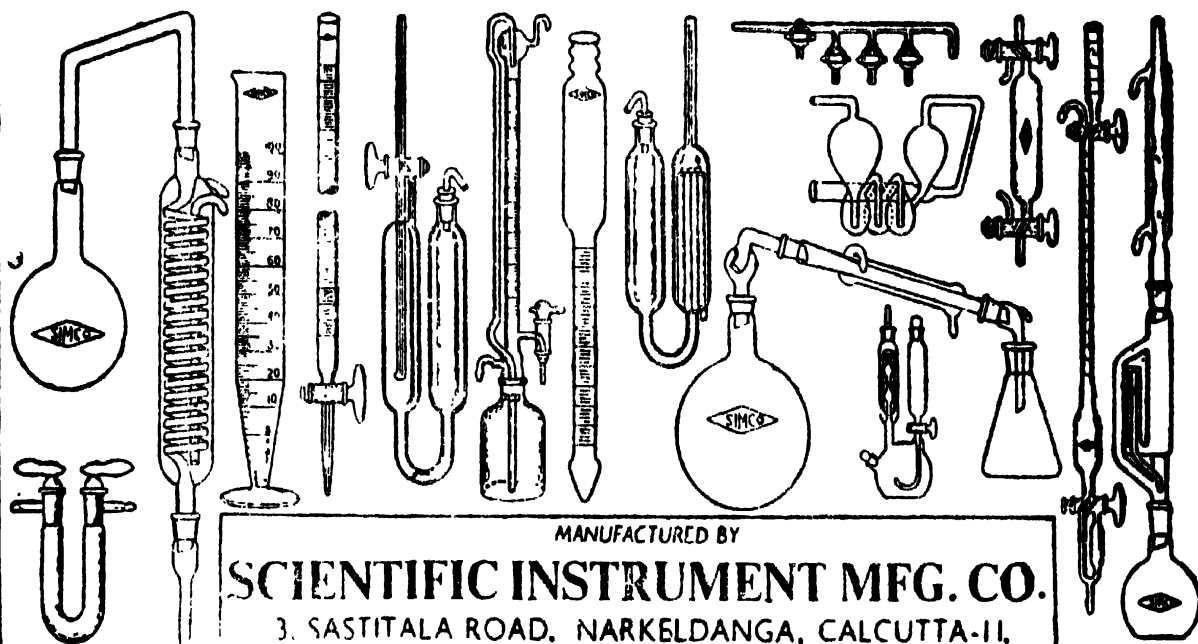
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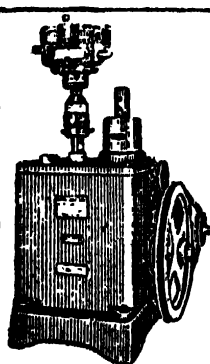
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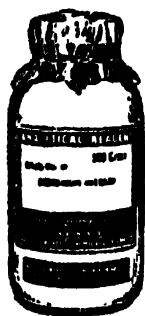
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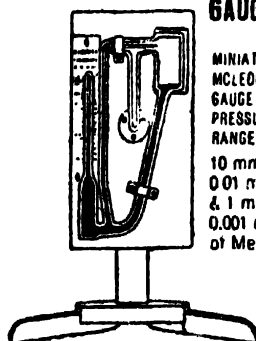
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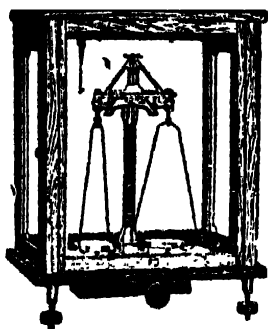


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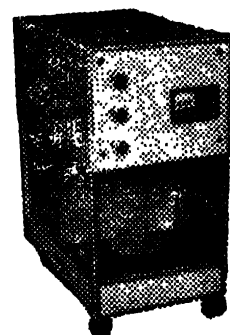
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THE INDIAN BOTANIC GARDEN

"A garden gone to seed" and "Will apathy kill yet another scientist?" The first statement is the title of a feature article from *The Telegraph Colour Magazine* (April 26, 1987) and the second the headline from a news item of *The Statesman* (July 4, 1987). The two unsavoury comments symbolise the current state of affairs at the Indian Botanic Garden (IBG) which has plunged into a year-long bicentenary celebrations commencing from July 6, 1987. The Garden authorities reportedly plan to present its employees with wrist watches as a component of the festivities. It would augur well to gift its scientists with better working facilities and the public with a garden that needs to spruce up instead of the prevailing rundown condition.

The celebrations began by offering floral tributes to Col. Robert Kyd (1746-1793) who supposedly set up the Garden on the west bank of the River Hooghly two hundred years ago. Among others, Mr. Alokudut Das, Mayor of Howrah and Prof. H. Y. Mohan Ram, Department of Botany, University of Delhi, placed wreaths at Kyd's monument—an exquisite marble kept at the Centre of the Garden. In order to commemorate the occasion, Prof. Mohan Ram released a book entitled "Network of Botanic Gardens" and edited by Dr. M. P. Nayar, containing articles contributed by about 40 leading botanists from India and overseas. The 38th Vanamahotsava was observed with full dignity and saplings were freely distributed. A further programme has been chalked up to celebrate

the bicentenary. A glass-dome conservatory will be erected. A life-size model of a dinosaur—Christened *Barapasaurus tagorei* after Rabindranath Tagore—the first of a great Indian animal species will be installed; the model, 1.5 m in length and of a species that once dwelled in the country 180 million years ago, is based on a skeleton discovered in the Chandrapur district of Maharashtra by the Indian Statistical Institute. Other items in the pipeline include the construction of a bicentenary gate (overlooking the Andul Road), an exhibition hall, a lecture room and a guest house (to accommodate researchers). There will be a mobile exhibition of Indian plants all over the country. Indian flowers will be displayed and commemorative postage stamps issued. A symposium will be organised in which world's top-notch botanists are expected to participate. Finally, ambassadors of various countries stationed in New Delhi would be invited to plant saplings to invoke "peace in the world".

A confusion exists as to the exact date of establishing the Garden. According to one version, the seeds of the Garden were planted in 1784 by the then Chief Justice of Calcutta, Sir William Jones. He felt the need of a Garden that would harbour botanical specimens. He mooted a proposal to the East India Company to clear out a piece of territory at Shibpur which formed a dense jungle infested with man-eaters. His proposal was accepted and the Company Garden, as it was then named, was formally inaugurated

on July 6, 1787. There is another view that Col. Kyd despatched two letters to the Board of Directors in London about his plan early in 1787. The Directors forwarded the letters to Sir Joseph Banks, an eminent botanist and custodian of King George III's Botanical Garden in London, for his opinion. Sir Banks recommended Kyd's plan on July 6 of the same year and the Directors eventually approved it. In a letter, dated July 31 of the same year, they wrote to Kyd: "In the cultivation of the cinnamon tree in particular we foresee a great source of wealth to the Company and to population and opulence to the province". So the Garden came into existence due to the munificence of the East India Company and the interest of Kyd who was entrusted with the job of selecting the site. In view of the fact that the area was inaccessible, a road was laid down on the east side of the Hooghly and was aptly styled Garden Reach Road. After the Sepoy Mutiny of 1857, the East India Company was dissolved and the Garden was officially designated the Royal Botanic Garden during the reign of Queen Victoria. In order to oversee the work of the Indian counterpart, the authority was ultimately vested with the Royal Botanic Garden at Kew, Surrey, England. The present name was acquired in 1952. It was run by the Govt. of West Bengal till 1963 when it was handed over to the Centre by an Act of Parliament. At the initial stage, the Union Ministry of Education and Cultural Affairs took charge of the Garden. It was then attached to the Ministry of Science & Technology until 1972 and then shifted to the Department of Environment in 1982. Such changes/transfers have not been healthy for the development and maintenance of the Indian Botanic Garden.

After the terrible famine that struck Bengal in 1777, the Garden was envisaged to produce subsidiary food to meet the scarcity conditions and serve the East India Company in its commercial enterprises. Thus, the Garden was founded "not for the purpose of

collecting rare plants as things of mere curiosity or furnishing articles for the gratification of luxury, but for establishing a stock for dissemination such articles as may prove beneficial to the inhabitants." It soon became a centre of taxonomic and phyto-geographical research and an agency of plant material of economic significance between India and farthest corners of the globe.

The Garden covers an area of 110 hectares and has over 12,000 plants. These plants are grouped on a geographical basis, i.e., the typical plants of a particular country are planted in a specific area allotted to them and are growing in harmony with the climatic conditions congenial to them.

The IBG is probably the largest in Asia. It is acclaimed for its plant introduction work, about 80 species being successfully introduced during the last 75 years. Some of the achievements of the Garden include the cultivation of aloe, cocoa, coffee, cardamon, India-rubber, henbane, Japanese mulberry, sarsaparilla, tapioca; improvement of Indian cotton; introduction of cinchona, mahogany, tea; utilisation of jute, etc. Sir Joseph Dalton Hooker, author of the *Flora of British India* (which is still used 40 years after independence and in the absence of a *Flora of Free India*), remarked that the Garden has "contributed more useful and ornamental tropical plants to the public and private gardens of the world than any other establishment before or since."

The Garden houses, the Central National Herbarium (CNH) which dates from 1832. Previous to this date, collections were made by the Herbarium. But they were taken to Europe by Nathaniel Wallich (1716-1854) and distributed by him to various institutions. The Herbarium is a veritable repository of plant specimens dried, pressed and arranged in the sequence of an accepted classification. It includes 10,000 type materials and over 12,000 Wallichian specimens. Approximately 12,000 photographs of Indian and other authentic specimens from the Kew Herbarium, British Museum and Linnaean Herba-

rium, about 4,000 drawings/illustrations and microfilms from 26 European herbaria have been procured. Nearly 250 new taxa have been described and new reports of distribution embracing more than 500 species have been from India.

The cynosure of all eyes in the Garden is the Great Banyan tree which is one of the largest trees in size in the world. Today, it is an object of admiration and wonder. It looks like a miniature forest rather than an individual tree and this appearance is caused by the hundreds of aerial roots which hang down from the branches to the ground, attaining striking development as subsidiary trunks. There are 1,825 such aerial roots actually anchored to the soil, the main trunk being removed in 1925 as it was afflicted with a fungus disease. In a sentimental move, a white marble tomb has been built where the main trunk lay. The canopy of this fantastic tree has a circumference of 245 metres and the maximum height achieved by one of its branches is 29 metres. The age of the tree is estimated to be over 250 years.

Besides the Banyan tree, the interesting show-spots in the Garden are the small palm-house, large palm-house, orchid-house, fernary, branching palms, screw-pine collection, bamboo and pinetum collections, cacti and succulent collections, giant water-lily of the Amazon, green meadows, array of winter annuals, delightful walks, imposing lakes and picturesque vistas. Germplasm collections of *Bougainvillea*, *Citrus*, *Jasminum*, *Nymphaea* and *Vitis* and a section on medicinal plants have been developed in recent years.

While the immediate preceding paragraph has been quoted from one of the publications put out by the Botanical Survey of India (BSI) to which IBG now belongs, there has been utter neglect of the sprawling premises since the Director of the Survey decided to operate from three offices and frequent the Garden as and when the occasion arises (contrary to the recommendations of the joint

review committee on BSI-ZSI which favoured the functioning of the various units of the Survey in and around Howrah from the same station). As a consequence, IBG's cup of misery is full to the brim and woes of the Garden can be enumerated. Cattle grazing on the unkempt grounds and cut wooden stumps are a common sight. Dead and decaying foliage shed from trees stay in untidy heaps. Branches of trees are regularly felled by urchins and the security staff of the Garden are not adequate to tackle the problem. Plants are being stolen from the nursery and a section of the employees are allegedly in league with such thieves. The presence of a retinue of durwans and even a police outpost plus a posse of professional security-men has not changed the situation. Over-grown shrubs and straggling grass line the Garden. The only redeeming feature is the manicured lawns surrounding the CNH and other buildings of BSI. Excursion parties from schools and colleges are regularly herded into the Garden. No efforts have been made to tag the trees properly, although a few boards labelled *Tectona grandis* are evident. Public toilets are few and far between; the ones in use are despicable and none of them has a door. The few new toilets that have been added are securely locked for some unknown reason. The 25-odd lakes that have been excavated are silting over the years, leaving hardly any water in them. Slime moulds have spread over the water surface, aquatic algae and *Hydrilla* plants forming an impenetrable layer. In the past, feeble attempts have been made to dredge the lakes; plant remains and dried algae are deposited on the shores. Whereas each lake has been assigned to one employee for maintenance, children of employees are frequently seen catching fish and bathing in water and their womenfolk wash utensils and clothes. Finally, the Garden is in charge of a person who has neither the background nor the training in horticulture and landscape gardening. His sole qualification lies in raising

jute plants in pots and treating them with water-hyacinth extracts ! Currently, he is dabbling in tissue culture—the latest gimmick for an indoor-scientist. Perhaps, he would insert all the trees of the IBG into test tubes and then invite the public to gaze at them when celebrating the anniversary of the Garden's starting date !

There are over 500 botanic gardens in the world. They are of value not only to botanists, foresters, horticulturists, home gardeners, landscape gardeners, nursery people, seedsmen but also to thousands of tourists. "Most of them are open to the public and many offer instruction with special lectures and demonstrations to meet the needs and interests of individuals in all walks of life". Are the Garden authorities aware of the various roles of a botanic

garden ? If aware, how have they gone about in fulfilling them ? One is reminded of a flower show organised by the IBG for the last three or four years and even the Royal Botanic Garden at Kew (by which they pretend to swear) do not indulge in such a stunt.

A lot of devotion, hardwork, imagination and sacrifice on the part of the British scientists and their Indian colleagues over the past two centuries have gone into the making of the IBG. At a time when the Govt. of West Bengal is demanding the return of the Education portfolio from the Concurrent List, will it not be advisable for them to ask the Centre for the custody of the Garden that is slowing sliding towards rack and ruin ?

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S. C. Datta

GENESIS OF FLOODS IN WEST BENGAL AND THEIR IMPACT ON SOCIETY

BIRESWAR BANERJEE*

ABOUT three-fourths of the total area of West Bengal excluding her western plateau and northern hill and foothills lie within the Ganga-Brahmaputra Delta, also known as the Bengal Basin. The Bengal Basin is characterised by its flat riverine terrain being formed of the alluvium deposited during floods. The flood plains of West Bengal continue to be the principal economic hub of the State, being noted for fertile soils, most productive farmlands, thick concentration of industries, dense cluster of settlements and diverse communication networks. When river overflows its bank, flood is the result. Limited floodings are beneficial to crops and improve the fertility status of the soil by deposition of fine detrital matter over it. When the magnitude of flood exceeds the tolerant limit, it causes colossal

damage to life and property, houses and crops, roads and railway systems and in other walks of life. In West Bengal, floods are a common phenomena and cause considerable damage to life and property every year. Despite the risk associated with floodings, people prefer to live in dense concentrations over the flood plain because of its fertility and better accessibility. During the last three decades or so, millions of immigrants have put up their settlements on the flood plains by removing the natural vegetation. In the process, the natural drainage lines have been disturbed and indiscriminate growth of industries has taken place in areas normally prone to floods. As a result, high magnitude floods are frequently causing more and

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more damage in recent years than in those days when the plains were mostly used for agricultural purposes. The devastating flood of September-October, 1978 may be cited as an example, in which thousands of people had lost their life, hundreds of thousands of livestock were perished, millions of huts were gutted and millions of rupees worth of foodgrains were destroyed. During 1978, 12 out of 16 districts of the State were affected covering an area of about 30,000 sq km.

Notwithstanding the measures taken by the Damodar Valley Corporation, the Mayurakshi or the Kangsabati projects during the Plan Periods (since 1951), floods are becoming a frequent phenomenon in West Bengal. This naturally raises grave doubt about the efficacy of the flood-control measures so far adopted in this State and the hazards of an uncontrolled drainage system in the lower courses of the Mayurakshi, Damodar and Kangsabati river system.

Flood-prone areas

It has been estimated that more than 50% of the total area of West Bengal are flood-prone. The specific regions where floods are common are noted below :

- (i) The lower reaches of the Tista-Jaldhaka-Torsa plain in Jalpaiguri and Cooch Behar district.
- (ii) The Ganga-Mahananda and the Punarbhaba-Atrai interfluvium in Malda and West Dinajpur district.
- (iii) The western Bhagirathi plain in Birbhum, Murshidabad and Burdwan district.
- (iv) The Jalangi and Churni Plain in Murshidabad and Nadia district.
- (v) The dead and dying deltas of the Hooghly-Damodar-Rupnarayan-Kasai and Kaliaghai rivers.
- (vi) The marshy tracts in the east and central parts of the State.

Flood intensity is high near the outfalls of the tributaries of the Bhagirathi-Hooghly

river. Intensity is also high in the Katwa-Purbasthali-Nabadwip area.

Periodic floodings are common in the low-lying areas of the Sundarban and Midnapur coast during high tides. It is interesting to note that North Bengal suffers from early floods during June-July, whereas, in other areas floods generally occur in August-September, with maximum frequency in September.

Depth and duration of flood

The average depth of the flood water and its duration depends largely on the surface configuration and meteorological conditions of the area. The slope of the ground, vegetation cover, intensity and duration of rainfall, nature of the soil, character of the outfall channels are some of the factors determining the depth of flood water in a region. The depth is high in the inter-riverine tracts of the delta face. Due to diverse morphometric patterns of her terrain and varied meteorological characteristics, the magnitude of flood inundation varies from place to place in West Bengal. For example, the average depth of flood water from the Bansloi-Dwarka-Mayurakshi-Ajay outfall to the Bhagirathi-Jalangi confluence is about 3 m. The depth of flood water is also considerable in the Katwa-Nabadwip area. In the inter-riverine depressions of the Damodar Hooghly region and in the Kangsabati-Kaliaghai interfluvium, flood occurrences are frequent and their duration is long. The depth of the ground-water creates ideal conditions for prolonged water-logging. This depth becomes less in the Damodar-Dwarakeswar-Silai and Kasai basin in September than in May. As such, these areas are flood-prone towards the later part of the monsoon months.

Causes of floods

The causes of floods are partly natural and partly man-made. A regional flood is usually associated with the passage of a

cyclone, being accompanied with heavy or fairly persistent downpour. Heavy rainfall in the catchment area along with melting of snow and ice over the Himalaya may cause flood in the North Bengal Plain.

The catchment areas of most of the rivers of this State are over-utilised with excessive grazing, deforestation and unscientific farm practices. These factors naturally accentuate the volume of run-off, thereby encouraging soil erosion and subsequent removal of the detritus to the river beds. The cross-sectional areas of the river beds become progressively shallower, changing their character to wide aggraded channels. The water-holding capacity of these rivers are thereby decreased. The extra-load of water which drains into the river during the spell of high rainfall are spilled over the banks and inundate large areas of the countryside. Over-grazing of the natural pasture lands, wanton destruction of natural forest cover, setting up artificial embankments along river sides and putting up new settlements on the natural drainage lines are some of the factors which are disturbing the ecological balance. Progressive silting of the river bed usually chokes the outfall channels, causing more frequent floods at present than in earlier years.

North Bengal : In the northern districts of Darjeeling and Jalpaiguri, floods are generally caused by concentrated monsoon rainfall in early monsoon, viz. June-July, being synchronised with the melting of snow in the Himalaya. Such natural phenomena as landslides or earthquakes accentuate it. Ruthless deforestation of the catchment areas may be considered as an important contributory factor for floods in North Bengal. The average storm rainfall occurring during the bursting of the monsoon often exceeds an intensity of 2.5 cm in an hour. Absence of sufficient forest cover, along with landslips and steep slope encourage the rivers in scouring enormous amounts of sediments, which are deposited on their beds in the

piedmont belts. The extra volume of gushing water, therefore, spills over the river banks and inundating the surrounding areas with sand, boulder and silt. The integrated pattern of the drainage system aggravates the flood problem in North Bengal rivers. Thus, in case of an early flood in the Brahmaputra, the North Bengal rivers lying east of the Tista are swelled up, while their own waters are distributed in the adjoining countries. The Tista flood of 1968 was caused by concentrated heavy rainfall in the catchment areas along with landslide jumbling on the river bed at an early stage, thereby creating an artificial reservoir and its subsequent removal and sudden release of water at a later stage.

Central and Eastern Regions : In case of central and eastern part of this State, the rivers being cut-off from their headwaters are unable to carry the full load of sediments with them and instead deposit them on their beds. Any extra volume of water is, therefore, spilled over the surrounding low-lying areas. The Ganga cannot take the extra volume of water from the Mahananda, as the former by that time is already swelled up due to the melting of the ice, snow and rainfall in its enormous catchment area of about 9.1 million sq km. In the tidal rivers like the Hooghly or the Matla, tides redeposit the silts on the river beds. The spring or flow tide being stronger carries the silt upstream, what the weaker ebbtide carries down. The lower reaches of the Bhagirathi-Hooghly catchment receive heavy rainfall during the later part of the monsoon season. Such a period of high rainfall occasionally coincides with the periods of high tides in the Hooghly and Rupnarayan river, thereby causing drainage obstruction and flooding of the countryside. Tidal obstruction and silting of the Hooghly, Rupnarayan and Haldi rivers occasionally cause floods in Tamluk region.

Western Section : In the western part of this State, particularly heavy monsoon rainfall is always associated with a cyclonic

depression which generally travel from the Bay of Bengal towards Ranchi-Hazaribagh plateau, i.e. from S-SE to NW direction. The course of the rivers, however, lies athwart to the path of cyclones. The average storm rainfall in the catchment areas of these rivers varies between 10 to 25 cm. As a result of such storms, the lower reaches of these rivers get swollen first and the upper portions of the catchment are subsequently affected. Due to higher relief, the upper catchment areas (Ranchi-Hazaribagh-Plateau) of these rivers get heavier rainfall than their lower counterparts. Unplanned deforestation in the upper catchment increases the volume and velocity of the surface run-off which overtakes the flow of the already choked lower section thus causing widespread floods in the lower segments of these river valleys in 5 out of 6 western districts of the State.

Genesis of the flood of 1978

The genesis of the devastating flood of 1978 may be cited as an example to clarify the above statement. It seems paradoxical to note that this flood was most devastating along the banks of the Mayurakshi, Damodar and Kangsabati river basins where millions of rupees have already been spent primarily for the construction of flood-control dams and flood-moderation barrages and secondarily for strengthening the irrigation and power generation capacities of this State. The genesis of the flood of 1978 may be attributed to the following factors :

- (a) Consistent and fairly heavy rainfall in the lower and upper catchments of the Bhagirathi-Hooghly River Basin.
- (b) Particularly heavy rainfall during the last week of September in the entire catchment area due to prolonged cyclonic depressions.
- (c) Inadequate storage capacity of the flood control dams of the DVC, Mayurakshi and Kangsabati systems, thereby necessitating release of reservoir waters causing further misery to the people.
- (d) Injudicious planning for regulating the discharge of flood water from the dams and barrages and lack of management of the water resources of the river valleys.
- (e) Progressive deterioration of the drainage outlet channels in the lower reaches of the Basin.
- (f) Lack of proper management of the river basins, particularly at their lower reaches.

It has been estimated that the western sector of the Bhagirathi-Hooghly Basin comprising the catchment areas of the western affluents of the river, on an average, receives 125-140 cm of rain (1948-1975 average). More than 80% of this annual rainfall occur during June to September, i.e. on an average between 100-112 cm. Rainfall incidences during this period in other parts of the Basin are a little higher. North Bengal, however, receives still higher rainfall (annual rainfall ranging between 175 cm to more than 400 cm). In 1978, the entire Bhagirathi Basin area received more rainfall during the monsoon months than the normal. The excess rainfall over the normal varies from district to district. But the amount of excess rainfall varies between 14% over the normal amount in Murshidabad district and 6% in Burdwan district.

TABLE 1 : Amount of rainfall received by the flood-affected districts of West Bengal during June-September, 1978

Name of the flood-affected districts	Rainfall (cm)	Deviation from normal in percentage
24-Parganas	199	+ 58
Nadia	135	+ 25
Murshidabad	127	+ 14
Birbhum	190	+ 61
Burdwan	194	+ 64
Bankura	147	+ 28
Midnapore	181	+ 50
Hooghly	155	+ 37
Howrah	198	+ 61

Of this amount again, the bulk (ranging from one-third to more than two-thirds of the monsoon precipitation) occurred in September. Naturally, most of the western river basins of the State were carrying sufficient volume of water. Moreover, sufficiently high rainfall resulted in a corresponding rise of the ground-water level, approaching in some cases near the surface. The capacity of the soil to absorb extra water, therefore, became restricted and low-lying areas were water-logged.

During the last five days of September, a number of cyclonic depressions from the Bay of Bengal passed over the entire Bhagirathi-Hooghly Basin causing very heavy rainfall during the period. The trajectory of the cyclonic depression was from E-SE to W-NW at the initial stage which moved towards Ranchi-Hazaribagh plateau and then turned towards the southeast. In the lower valley, it picked up moisture and regained its force and caused further rain in the south and southeastern portions of the Basin. The depression was finally lost dissipated near the Subarnarekha estuary. In addition, this major depression was further substantiated by another depression of minor intensity originating from the Bay and moving from SE to NW direction. As a result of this depression, upper catchment of Damodar-Kangsabati Basin received more than 60 cm of rain on September 27 and 28th and equally high amount in the lower reaches of the valleys during the following days. The average periodic rainfall during these five days was about 400 mm in Bankura, 750 mm in Birbhum, Burdwan, Howrah and Murshidabad districts (Table 2). According to Alipore Meteorological office, the amount was an all-time record in the history of the State. The dams and reservoirs of the river valleys were quickly filled up well above their danger level, as a result of the sudden ingush of water from their upper catchment areas. The lower valleys were also full with water occasionally spilling

over their embankments and levels. To protect the dams and barrages, release of water was absolutely indispensable in order to avoid the impending danger of their bursting. Simultaneous release of water from Tilpara on the Mayurakshi, Maithon, Panchet and Durgapur in the DVC and Kangsabati created conditions of unprecedented floods along these river-valleys and particularly in their lower reaches. As a result of the quick onrush of water, river-side barrages and dykes were quickly damaged thereby spreading the water to every conceivable places of the adjoining countryside and settlements.

TABLE 2 : Rainfall (cm) in Gangetic West Bengal during Sept. 26-30, 1978

Stations	Rainfall during Sept. 26-30, 1978	Rainfall in June-Sept. 1978	Normal Rainfall June-Sept.
Alipore	73.14	192.05	120.80
Dum Dum	57.26	155.27	113.70
Krishnagar	36.29	129.56	101.53
Mogra	58.85	146.88	113.70
Midnapore	28.25	162.78	115.41
Panagarh	66.95	171.56	116.16
Purulia	23.40	174.54	110.76
Sriniketan	61.04	166.29	109.91
Uluberia	61.94	179.91	120.29
Bankura	34.23	152.85	110.90
Berhampur	23.06	110.37	105.21

(Source : Compiled from the Records of the Indian Meteorological Dept., Calcutta).

Draining of water to the Bay through the Hooghly was further blocked by the prevalence of strong spring tides during this period, which thwarted back the flood-water into the upper reaches of the river during the first week of October.

It thus appears that the excessive rain was too much for the river systems with the limited storage capacity to drain. The four

DVC reservoirs at Tilaiya, Konar, Maithon and Panchet could prevent upto a flow of 6,000,000 cusecs. When the original project was conceived by Mr. W. I. Voorduin of the TVA (USA), it was decided to construct 8 dams with a storage capacity of 1,000,000 cusecs in the upper valley and 250,000 cusecs in the lower valleys. In September, experts estimated that the total discharge of the river within the DVC dams was of the magnitude of 850,000 cusecs. That is well above the designed storage capacity of the entire DVC system. Below Maithon and panchet dams and Durgapur barrage, an additional amount of 220,000 cusecs of water were added in the uncontrolled catchment area. Thus the total discharge after storing the full capacity of flood water of the DVC at the said dams and barrages was estimated to exceed 400,000 cusecs below Durgapur barrage and over 500,000 cusecs in the lower valley. It may also be mentioned that the present drainage condition of the Damodar river below Durgapur barrage does not permit the river to carry more than 100,000 cusecs of flood water. Identical conditions were experienced in case of Mayurakshi and Kangsabati basins. The life span of the DVC dams and reservoirs ranges between 60-70 years. In the absence of landscape management in the upper catchment, the dams and reservoir levels are quickly filled up with incoming sediments. Since their construction, nothing has been done to scour the reservoir beds. So the water-holding capacity of the reservoirs are decreasing at a rapid rate. This is a positive danger for the future. These factors naturally create favourable conditions for recurring flood hazards in West Bengal in the coming years.

Sudden release of water from the dams by the DVC and other authorities at the height of the floods made the conditions further aggravating. Water releases from the dams are probably unavoidable, but in case of recent floods, water is usually discharged at a time when the lower valley is heavily congested. In case of 1978 flood, the Durgapur and

Tilpara barrages (of the DVC and Mayurakshi respectively) released on an average over 400,000 cusecs of water during the last 4 days of September. Likewise, over 200,000 cusecs of water were released from the Kangsabati barrage. In fact, all the lockgates of the barrage were kept open since the mid-night of 26-27 September in order to drain off the rapidly accumulating water from the dams and barrages. Despite these measures, the flood-water over-flowed the Tilpara barrage for certain periods on September 27. The damage could have been much less if water-discharging information could be made available to the people of the lower valleys in advance. The DVC actually sent discharge warnings to the district authorities, but very few people had prior information of the impending danger due to the existing information gap between district head-quarters and villages.

The dam executives probably wanted to store the flood water for future use in irrigation and power generation. So the reservoirs were allowed to be filled up considerably leaving very little flood cushion for the heavy rain of the last 5 days of September. But unless weather-forecasting system is improved, such erroneous judgement is inevitable. If the depression originating from the Bay could be forecasted a few days in advance, the reservoirs could have been sufficiently drained to allow their subsequent filling by the storm-rain.

Inadequate flood-flushing of the Damodar-Rupnarayan system during the first three months of the monsoons because of the construction of dams on the river bed have led to the progressive deterioration of the lower valleys by silting. Their drainage outlets to the Hooghly have been seriously affected. Lack of sufficient flushing from these western river systems has its effect on the progressive deterioration of the Hooghly river. The average inflow of Ganga water from Farakka in recent years within the Bhagirathi-Hooghly system has not yet been able to revitalise estuarine channel of the

Hooghly river. As such, flood-water discharge through the shallow river beds and silted up Hooghly estuary remains poor.

The gradients of the rivers are also a contributory factor. In the upper valley the gradient is steep (2 m in 1 km) where it takes comparatively little time for the surface run-off to collect in the rivers. Thus, the flood discharge suddenly increases in volume. In the lower reaches, however, the rivers flow through very low gradients wherein surface drainage is blocked by the river levees.

It has thus become apparent that floods are inevitable in West Bengal under the existing physico-meteorological conditions and escape from them in the near future is not feasible as the control measures so far executed appear to be quite inadequate for the purpose.

Conclusions

The prognosis of the recent floods give rise to the realisation that there are no escape from floods in West Bengal under the existing situation and the people should keep themselves prepared to live with this natural hazard at least in the coming years. It is, therefore, the opportune period to devise means and measures for its prevention and to reduce its damage. Investigations of the various problems associated with this natural hazard in West Bengal and to adopt both short-term and long-term measures to ameliorate them should now be carried on in right earnest. Some of the measures necessitating immediate attention are evident from the present analysis. These are enumerated below :

(1) Effective measures to landscape planning of the catchment areas with an emphasis on detention of flood-water movement in the reservoirs. To achieve this objective, a long-term policy of afforestation in the upper catchment area should be taken up. The velocity

of run-off in the hill and plateau section of the catchment can be effectively controlled by inter-position of vegetation. It has been estimated that loss of water and soil from a bare upland is 125 and 800 times more respectively than in a forest-covered area. In this way, rapid silting of the reservoir can also be progressively minimised.

- (2) Formulate plans and implement measures for the improvement of drainage outlets of the lower valleys. Silt problem in these areas should be studied and special means should be adopted to increase the discharge capacity of the rivers.
- (3) Augmentation of the present storage capacities of the reservoirs with construction of few more dams and reservoirs on the upper valleys.
- (4) Arrangements for periodic de-silting of the reservoirs so that the life-span of the reservoirs are not necessarily shortened. Heavy silt-laden water should not be allowed to settle down within the reservoir. They should be immediately discharged—a measure which can prolong the life-span of the reservoirs at the least cost.
- (5) Establishment of the requisite number of hydrometeorological stations and storm-forecasting centres. This will ensure better weather forecasting, thereby helping in removing the present anomaly in regulating flood water releases and its storage in the reservoirs.
- (6) Construction of a network of flood-discharge-cum-irrigation-channels, through which the excess flood water may be distributed uniformly over as large an area of the countryside as possible. This will enable the distribution of surplus flood water and silt over the valleys by overflow system of irrigation, thereby ensuring bumper crops in the next har-

vest. Such a system was in vogue in the Damodar valley prior to the 19th century and was found to be most effective.

- (7) Revitalisation of the irrigation channels. Most of the irrigation canals of West Bengal are unlined and exist as earth-trenches. As such, the channels are quickly silted up with their parent detritals or filled up with sediments of released irrigation water. The water-holding capacity of the canals is thus much restricted. Lined canals as in case of the Punjab or Haryana can carry more volume of water and ensure its efficient movement. In case of lined canals, extra volume of water can be efficiently spread over the farmlands.
- (8) Identification of the flood-hazard areas and control of human settlements or economic activities in these areas. Existing settlements should be protected by adequate embankments. The rural settlement sites should be raised above the high-flood level wherever the programme is technically and economically feasible.
- (9) Formulation of national policies of flood control and water-resource management. Formulation of such policies and their implementation necessitate

participation of people from various walks of life and co-operation of State, Central and local levels of government. The flood-control programmes should be considered within the framework of the river basin management.

Thus, future programmes should be undertaken in a comprehensive way which form a part of the combined water-resource development of a river basin such as irrigation, power generation, aquaculture, navigation, etc. If misuse of land is avoided from the top to the bottom of a valley and if the ecological balance of the valley is not disturbed by unnecessary human interference, almost any river can be controlled. But the task is so big and involves so many human interests that full control upon a river has not yet been achieved by any country of the world till now. □

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NOTES & NEWS

Compost kills plant diseases

Nurserymen, farmers and pot-plant lovers will all benefit from improvement of a property of compost that is being carried out by microbiologists at the Hebrew University's Faculty of Agriculture, Rehovot, Israel. These scientists have verified experimentally that when compost is incorporated into potting soils for nurseries and greenhouses, it sup-

resses soil-borne pathogens that harm plants. They have found that compost does this by a biological action unrelated to chemical agents.

The staple ingredient of potting soils has always been peat, a highly organic soil composted of partly decayed vegetable matter. This is mixed with a mineral component consisting of small pieces of light stone, such as tuff. Because world deposits of peat are being rapidly depleted, the material is becoming more expensive.

Yona Chen of the Seagram Centre for Soil and Water Sciences and Yitzhak Hadar of the Department of Microbiology and Plant Pathology there, are investigating various composts (manufactured mixtures of decaying organic matter, leaves, manure, etc.) for adding to peat or even replacing it in potting soils. They have found that addition of a proportion of local Israeli compost to potting-soil mixtures not only improved their suitability for plants but helped to retard soil-borne micro-organisms detrimental to plants. In their work, researchers have collaborated with H. A. J. Hotink of Ohio State University, Columbus, Ohio USA, with the objective of producing a fortified compost. In their study of local Israeli composts, such as composted licorice roots and of composted grape residues from wine-making, it was noted that the licorice-root composts suppressed pythium-fungus damping-off disease in cucumber seedlings and the grape-residue compost suppressed rhizoctonia-fungus damping-off in radish seedlings.

The effect was not observed if the composts had been left to mature or if mature compost had been sterilised. This indicates that the effect is biological, i.e. certain bacteria and fungi that suppress the disease organisms must be allowed to develop in the compost. These composts and others are today being used in plant nurseries. The scientists are studying the nature and identity of the organisms responsible for suppressing the diseases and the exact conditions for their colonisation of the compost in order to improve and intensify this property of compost.

The development of a fortified compost, which can efficiently suppress disease in potting soils, will reduce nurserymen's fear of diseases occurring in potting mixtures containing peat. It will also reduce the need for sterilising the mixture, save money used on buying chemical-sterilising agents and reduce expenditure on imported peat. □

News From the Hebrew University of Jerusalem

Don't open, sesame

An improved sesame variety whose capsules all ripen together has been developed by Amram Ashri, Department of Field Crops, Hebrew University, Jerusalem, Israel.

Unlike other domesticated seedplants, sesame has anomalously retained traits essential for survival in the wild, but which are drawbacks for cultivated crops. As the capsules ripen and dry, they open and scatter their seeds. This precludes direct mechanical harvesting. Since each plant ripens unevenly over a long time, any single harvest date causes loss. For this reason, sesame cultivation is now confined to lands where manual labour is cheap, such as Burma, India, Sudan and some Mediterranean countries.

Sesame is an important constituent in crop rotations, especially in dryland agriculture, as it can grow on stored water in the soil without irrigation and it improves the soil structure.

The high-quality oil for which sesame is mainly grown does not turn rancid and is used after extraction for the seed without any further special refining for salads, cooking and margarine manufacture. The meal which remains after the oil is extracted is rich in proteins that can replace meat and has been recommended by the UN Protein Advisory Group for human nutrition. Sesame is also used whole in baking, in sweets, in halva and as a ground paste—tehina—which is a salad dressing and a sauce.

Ashri used irradiation to produce a variety of sesame plants in which all the capsules ripen together and which is stable and breeds true under varying agricultural conditions. He then successfully crossed the evenly ripening sesame with a variety discovered in Venezuela some years ago which does not scatter its seeds, but which to date has presented breeding difficulties.

Ashri and his collaborators have now succeeded in producing a number of lines of sesame which combine several desirable qualities : early ripening, non-scattering of seeds and an improved branching pattern in which all the capsules are held at the top of the plant some 80 cm off the ground. These lines will be easier to harvest with a mechanical harvester, but even in those places where hand-harvesting will continue, the new plants will be of great benefit due to their early ripening and seed-retaining capacities. Trials are being carried out in collaboration with researchers in Thailand and other countries. In May, 1986 Ashri planted a hectare (10,000 m²) of breeding lines at Rehovot. When these plants have been finally tested and multiplied so that they can be widely grown, they will enable this important oil-seed plant to assume its proper place as a major crop in advanced countries and thus to make a marked contribution to world nutrition. □

*News from the Hebrew
University of Jerusalem*

tant point is that when the successive sheets are laid down, they are slightly skewed from each other. It is this spiral effect that gives the cell wall its strength.

Vian and Roland reviewed literature on these spirals in cell walls and found that the cellulose usually turns in direction between eight and ten times in the history of a cell. But each shift is susceptible to disturbances in or around the cell. For example, a sudden change in the plant's water supply, when a sheet of cellulose is being laid down onto another will rupture the join, creating a "scar" in the cell wall. Chemicals that affect the cellulose, such as herbicides, also leave their mark. Using a change in water supply to lay down a time marker in the cell wall, Vian and Roland noted that it takes about 3 hr to lay down each cellulose layer. The periods are regular, but vary from species to species.

If Vian and Roland are correct, the cell wall is a molecular data store. And developing a wall chronology could help to reconstitute the history of a cell. □

New Scientist

Cell walls as clocks

Plants can be, quite literally, chunks of recorded history. A good example is the cross-section of a giant redwood tree in the Natural History Museum, London. It dates back beyond 1066 and the rings in the wood tell us much about how the tree grew each year, for instance, in bad years the rings are denser and thinner than in good years. Now Brigitte Vian and Jean-Claude Roland, at the Ecole Normale Supérieure in Paris, say that the billions of cells in a tree ring or any other plant tissue.

Each plant cell is enveloped in a strong corset of cellulose, aptly called the cell wall. The cellulose is arranged in thousands of parallel fibres, stacked in sheets and sandwiched together like plywood. The impor-

Announcements

I

The thirty eighth Associateship Examination of the Institution of Chemists (India) will be held in November, 1988. The last date for Registration is 30th November, 1987. This Examination in Applied Analytical Chemistry is divided into the following eleven Sections and each candidate will be examined in two of them in addition to General Chemistry including Organic, Inorganic, Physical and Applied Analytical Chemistry :

- (1) Analysis of Minerals, Silicates, Ores and Alloys ;
- (2) Analysis of Drugs and Pharmaceuticals ;
- (3) Analysis of Foods ;
- (4) Analysis of Water and Sewage ;
- (5) Bio-chemical Analysis ;
- (6) Analysis of Oils, Fats

and Soaps ; (7) Fuel and Gas Analysis ; (8) Analysis of Soils and Fertilisers ; (9) Analysis Connected with Forensic Chemistry ; (10) Analysis Connected with Leather Chemistry ; (11) Analysis Connected with Textile Chemistry. The A. I. C. Diploma obtained by passing this Examination is recognised by the Government of India as equivalent to M. Sc. in Chemistry for purposes of recruitment of Chemists.

Enquiries for details regarding this and for Membership may be sent to the Honorary Secretary, Institution of Chemists (India), 11/1, Dr. Biresh Guha Road, Calcutta-700017.

□

II

The VII National Symposium on Tobacco

will be held during January, 1988 at Anand, Gujarat, for two days, after the A. I. C. R. P. (Tobacco) workshop. Actual dates will be announced later.

The Symposium consists of (1) invited lectures by eminent scientists, (2) presentation of selected scientific papers, and (3) poster session.

The papers should be written as per the format specified for the journal *Tobacco Research*, typed neatly on $\frac{1}{2}$ demy size bond paper, and should be sent in duplicate to the Secretary before 31st October, 1987 positively.

The Registration fee for participation in the symposium is Rs. 100/- per delegate/participant, and this amount should reach the Secretary, before 15th December, 1987. □

BOOK REVIEWS

J. C. Bose speaks—Edited by Dibakar Sen and Ajay Kumar Chakraborty. Puthipatra, 9 Antony Bagan Lane, Calcutta-700009, pp. vii + 456, Rs. 75/-.

The writings of J. C. Bose form a part of our scientific heritage and history, yet for some strange reason no effort had so far been made to make them available to an all India readership in a suitable form. The Bengali readers however are somewhat fortunate in this regard, for they have at least a cursory acquaintance with a few of his classic prose pieces. But in spite of Bose's deep love for the vernacular, the bulk of his writings were in English. It is therefore very gratifying to find that at long last an attempt has been made to bring out a volume containing a selection of his articles, lectures, letters, excerpts from diaries and other writings. They span a long period of almost forty years. We congratulate the editors for undertaking the pioneering work and the Publisher for bringing it out.

The material is presented in five sections. Each entry is preceded by a short note giving the necessary references which put the pieces in their proper perspective. This is the most valuable feature of this collection. The editors however could have given the references in the usual way stating the volume number, issue number and page numbers of the journals/books referred to for the benefit of the interested readers and researchers.

Section I contains twelve entries—articles and lectures on general topics. These are not arranged chronologically. The fourth entry in this section 'The promotion of advanced study of physics in India' which appeared in the *Electrician* when J. C. Bose was in England is the earliest, the article on Rammohan reprinted from the commemoration volume of the Rammohan Roy centenary celebrations in 1933 is perhaps his last. Also included in this section is his famous inaugural address on the foundation day of the Bose Institute 'The Voice of Life'. 'The Uphill Way'—another lecture however does not mention the year in which it was delivered.

Section II has sixteen entries—addresses, invited talks and lectures. These include J. C. Bose's presidential address at the Lahore Science Congress held in 1927, the address at the Bengali Literary Conference held at Mymensing in 1911. The interesting thing about the second lecture is that he give it twice, in Bengali and in English. As in Section I, the editors have dug up historical material to provide a background. As a sample we reproduce the editor's note attached to "Reply to the Address of the Citizens of Calcutta on the 25th January, 1921".

"The following address was delivered by Sir J. C. Bose at Town Hall, Calcutta, in a reception convened by Dr. Chunilal Bose, the Sheriff of Calcutta, for presenting an address of felicitation to him on behalf of the citizens of Calcutta. The reception was gorgeous and attended by leading members of Indian Community. The Maharajah of Kassimbazar proposed Sir Abdur Rahim to the chair. Sir A. Choudhury then read the address on behalf of the citizens. The address was inscribed on palm leaves made of gold. The cover was an embossed cross thunderbolt, the emblem of the Bose Institute, in gold. It was presented on a silver tray, along with a silk chaddar, unhusked rice, a tiny bunch of green coconut, a silver cup containing sandal paste and red pen made of gold".

Section III presents fragments from his note books and diaries. His diaries contain glimpses into the battle he had to fight to overcome European antagonism of the prevailing idea that the East being the land of spiritualism is far away from modern science, the clippings from his file are no less fascinating, for instance the Eleven Commandments to the Younger generation : "Whatever you do, do it greatly, if a lawyer, be a great lawyer, if a scientist, a great scientist"....."Prove to the world that its advance will be incomplete without your contribution". These clippings were pre-

served because they echo his own ideas, his passion for perfection. These are valuable documents for biographers and historians of science. One example will suffice :

"I have been long thinking whether the vast solar energy that is wasted in the tropical regions, can in any way be utilised. Of course, trees consume solar energy. But is there no way of directly utilising the radiant energy of the Sun ?

Taking advantage of the heating effects, there have been attempts to construct Solar Engine which is merely a Heat Engine. We may also get thermo-electric current by heating one of the junctions. But such thermo electric batteries are practically of not much use. Great amount of energy is also lost by wasteful conduction. Now I have been thinking whether this could not directly convert the energy of light into that of electric current.

Sun-light by the intervention of chlorophyll decomposes CO_2 and thus we have carbon deposited. Potential energy being gained by the absorption of kinetic energy : Red yellow light is supposed to be the most potent factor in producing this chemical decomposition.

Now supposing there is no CO_2 to break up. In what form would the absorbed radiant energy be evolved ? Probably heat. But can we get electrical energy from the Radiant energy ? (5th March 1885)".

There are twenty selected letters (Section IV) written to eminent persons like Aldous Huxley, Romain Rolland, Borojen Seal, Motilal Nehru and many others. These also include letters written to the editors of the *Electrician* and the *Nature*. The letters though scattered are interesting and provide a lot of information and particularly the mood of a period extending from 1900 to 1928

Twenty-eight entries are included in Section V entitled—Exposition of his own Research. These are popular articles pub-

lished in *Englishman*, *Manchester Guardian*, *Modern Review*, *Scientia*, *Centura*, Transactions of the Bose Institute and some appear to be unpublished earlier. A few have been abridged from J. C. Bose published books. Editors state that they have chosen articles which have general appeal and are understandable to the common readers. After going through the fifty entries—articles, lectures, addresses and popular articles the immediate feeling is how many are left out. In Appendix II a chronological list of 129 scientific papers are listed. A similar chronological list of J. C. Bose's writings both in English and Bengali, other than scientific papers would help the readers to have a total view of the Acharya who introduced modern science in our country.

The Appendices also include a short

biography by D. M. Bose, a short essay on Indian Tradition of Science by Debabrata Bose and also reprints of interviews of the late Acharya by journalists.

The editors have used the spelling 'Jagadish' throughout the book without mentioning the reason for dropping the more accepted version of 'Jagadis', one may also question the basis of selection which seem rather arbitrary. But one must admit the value of such selections however random. It makes interesting reading to the curious laymen. For the more serious reader it provides fascinating glimpses, opening up vistas for further and in-depth exploration. Indeed the special merit of the book is that it whips up interest in the man behind the legend that was Jagadis Chandra Bose. □

Santimay Chatterjee

LETTERS TO THE EDITOR

Techniques for testing the efficiency of mesophilic cellulolytic fungal isolates

Role of micro-organisms in biodegradation of organic material is well recognised. Among the micro-organisms, the aerobic fungi which are mesophilic in nature, are most active especially in initial stages of degradation of organic materials and residues. The need for the isolation of effective strains of mesophilic microbes especially fungi is of prime importance to make the degradation process more rapid and successful through artificial inoculation in the recycled waste materials. So considering the facts, rigorous screening of such fungal strains are need of hour^{1,2,4,5}. With this view certain preliminary studies were organised to evaluate the comparative efficiencies

of the isolated mesophilic cellulolytic fungi.

The mesophilic cellulolytic fungi isolated by enrichment technique using Czepek Dox medium, out of which ten isolates on morphological character basis were identified upto genus level and selected for their comparative ability by growth of mycelium, cellulose decomposing ability and carbon dioxide evolution potentiality *in Vitro*. The growth of mycelium and cellulose-decomposing ability was judged by an experiment in 250 ml. Erlenmeyer flasks using filter paper discs as sole source of carbon by the method described by Garrett⁶ in Czepek Dox medium⁷. Whereas the CO₂ evolution experiment was carried out in one litre Erlenmeyer flasks using paddy straw as carbon source along with surface soil adopting the method of Premer and Schmidt⁸.

The results obtained by the above methods are described below :

In the first set of experiment cellulolytic fungal isolates were initially screened on the

basis of their proliferation in specific Czepek Dox medium containing filter paper disc. The wide variations in the mycelium growth of the tested fungus expressed in terms of mg (dry weight) in Table 1. The growth of

TABLE 1 : Relative growth performances of the isolated cellulolytic fungi in Czepek Dox medium containing filter paper

Isolated fungal strains	Dry weight of mycelium pads in mg at 15 days incubation
1. <i>Aspergillus</i> sp.	182
2. <i>Trichurus</i> sp.	217
3. <i>Paecilomyces</i> sp.	181
4. <i>Trichurus</i> sp. A	166
5. <i>Trichoderma</i> sp.	169
6. <i>Aspergillus</i> sp. A	177
7. <i>Penicillium</i> sp.	173
8. <i>Chaetomium</i> sp.	174
9. <i>Aspergillus</i> sp. B	173
10. <i>Penicillium</i> sp. A	171

the fungus at 15 days incubation ranged from 166 to 217 mg. Fungus sp *Trichurus* sp. showed optimum growth whereas the poorest

growth was observed in the case of *Trichurus* sp. A. The growth performance of the isolates could be arranged in order of *Trichurus* sp. > *Aspergillus* sp. > *Paecilomyces* sp. > *Aspergillus* sp. A > *Aspergillus* sp. B > *Chaetomium* sp. > *Penicillium* sp. > *Penicillium* sp. A > *Trichoderma* sp. > *Trichurus* sp. A.

So far judging the relative abilities of the isolated fungi for degrading the cellulose in a efficient way, the suggested method of Garret (1962) was adopted, Cellulose degrading potentialities of the isolated fungi as determined by calculating the mean loss of dry weight of the added filter discs in the same experiment conducted earlier (Table 2) were found to vary from fungus to fungus. Degradation of cellulose to the tune of 39 to 55 percent was obtained by the inoculation of the fungus isolates separately in the liquid medium. Percent decomposition of cellulose through the individual fungal cultures were as follows :

Aspergillus sp. 50%, *Trichurus* sp. 55%, *Paecilomyces* sp. 47%, *Trichurus* sp. A 46%, *Trichoderma* sp. 45%, *Aspergillus* sp. A 44%, *Penicillium* sp. 42%, *Chaetomium* sp. 41%, *Aspergillus* sp. B 40.5% and *Penicillium* sp. A 39%. It is evident from the above figures that the maximum utilization of cellulose was

TABLE 2 : Cellulose-decomposing ability of fungal isolates after 15 days of incubation

Isolated fungal strains	Initial wt. of filter paper (mg)	Final wt. of filter paper (mg)	Loss in wt. of filter paper (mg)	Percent utilization
1. <i>Aspergillus</i> sp.	200	100	100	50.0
2. <i>Trichurus</i> sp.	200	90	110	55.0
3. <i>Paecilomyces</i> sp.	200	106	94	47.0
4. <i>Trichurus</i> sp. A	200	108	92	46.0
5. <i>Trichoderma</i> sp.	200	110	90	45.0
6. <i>Aspergillus</i> sp. A	200	112	88	44.0
7. <i>Penicillium</i> sp.	200	116	84	42.0
8. <i>Chaetomium</i> sp.	200	118	82	41.0
9. <i>Aspergillus</i> sp. B	200	119	81	40.5
10. <i>Penicillium</i> sp. A	200	122	78	39.0

through *Trichurus* sp. followed by *Aspergillus* sp. The inoculum *Trichurus* sp. induced the maximum acceleration in degrading the cellulose followed by *Aspergillus* sp.

Carbon di-oxide evolution potentiality : Heterotrophs derive energy from the decomposition of organic matter, resulting in production of carbon di-oxide. Carbon serves both as energy source and is also required for cell protoplasm. Generally about 2/3 of the carbon is respired and evolved as CO₂. The quantity of CO₂ evolved is commonly used to indicate the level of degradation of organic matter through microbial activity. Fungal isolates were finally screened by testing their efficiencies in degrading the naturally available resistant material like paddy straw by the measurement of evolved CO₂ in term of mg of CO₂/100 gm soil. The data (Table 3) re-

appreciable variations in quantities of CO₂ generated were recorded. Maximum evolution of CO₂ by the activities of various isolates in straw amended soil was recorded at ten days of incubation. Amazingly, *Aspergillus* sp. proved to be the best decomposer of the natural organic substrate as evidenced by the maximum production of CO₂ as compared to the best pure cellulose decomposer *Trichurus* sp. inoculum.

The CO₂ evolved mg/100 gm of soil by the inoculation of isolated fungi in paddy straw mixed soil at 10 days incubation interval was as follows :

Aspergillus sp. 52.36, *Trichurus* sp. 46.34, *Paecilomyces* sp. 39.06, *Trichurus* sp. A, 26.24, *Trichoderma* sp. 25.31, *Aspergillus* sp. A. 24.39, *Penicillium* sp. 28.14, *Chaetomium* sp. 28.15, *Aspergillus* sp. A 29.21 and *Penicillium* sp. A 24.14.

TABLE 3 : Evolution of CO₂ in mg/100 gm of soil due to inoculation of various isolates of mesophilic fungal strains in paddy straw mixed soil

Isolated fungal strains	Period of incubation (days)						
	2	4	6	8	10	12	14
1. <i>Aspergillus</i> sp.	36.20	35.14	34.34	50.31	52.36	31.36	16.34
2. <i>Trichurus</i> sp.	28.90	28.70	26.32	39.24	46.34	27.34	14.28
3. <i>Paecilomyces</i> sp.	30.00	27.48	24.26	30.21	39.06	26.84	13.94
4. <i>Trichurus</i> sp. A	28.00	26.14	23.28	25.38	26.24	23.14	11.84
5. <i>Trichoderma</i> sp.	27.80	24.38	21.48	23.56	25.31	22.23	11.17
6. <i>Aspergillus</i> sp. A	27.10	23.94	20.86	22.88	24.39	21.40	12.38
7. <i>Penicillium</i> sp.	26.29	24.96	21.88	25.76	28.14	25.32	13.42
8. <i>Chaetomium</i> sp.	26.28	24.42	21.42	25.77	28.15	25.21	12.88
9. <i>Aspergillus</i> sp. B	26.29	24.36	21.38	26.23	29.21	26.42	14.32
10. <i>Penicillium</i> sp. A	25.81	23.48	20.49	22.88	24.14	27.12	13.89

aled that the respiratory rate of the paddy straw amended soil was raised substantially with the addition of the inoculum of the tested fungal cultures, specially in the initial stages of incubation. it is also observed that due to the differences in their competitive abilities to break down the paddy straw,

The relative performances on the basis of above adopted methodology, it is observed that on the pure and complex sources of organic matter, the tested isolates varied in their potentialities for their cellulolytic activity. The studies led to the screening of few efficient fungal strains which offered

scope for their culturing and use as inoculants in the rapid composting of organic waste materials. The fungal strains viz. *Aspergillus* sp., *Trichurus* sp., and *Paecilomyces* sp. gave conspicuous performance amongst the other isolates of fungal strains.

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Received : 29 December, 1986.

Revised : 20 May, 1987.

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Photo-sensitized oxidation of methyl parathion by singlet oxygen

The study of the photochemistry of organophosphates (pesticides) has been limited mainly to the name-brane phosphates such as Imidan¹, Dursban² and Guthion³ and in general little has been done to establish the mechanism of degradation. Most of the important phosphates, contain at least one sulfur atom, whose presence dominates the degradation pathways, but negligible infor-

mation is available for the photo-sensitized oxidation in the visible range of methyl parathion. So the present work was undertaken.

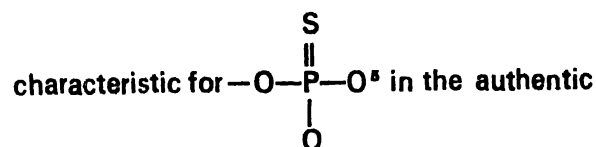
Methyl parathion (Technical grade) (0, 0-dimethyl 0- (p-nitrophenyl) phosphorothioate), 1, 4-diazobicyclic (2, 2, 2) Octane (DABCO), 1, 4-dioxane, methylene blue, methanol, lead acetate were used. A 200 watt tungston lamp was used for irradiating the reaction mixture. The infrared radiations were cut-off by water filter. Four drops of methylene blue ($2.0 \times 10^{-6}M$) were added to the methanoic solution of methyl parathion (5% v/v). The reaction mixture was aerated for 5 hours in the presence of light. The progress of the reaction was followed by TLC. The liquid layer was observed for 4 hours. The methylene blue adsorbed on these pesticides was removed by the addition of activated charcoal. The liquid product was separated by fractional distillation.

The boiling point of methyl parathion is 178°C and that of the photoproduct of methyl parathion is 205°C.

The product has been identified as the methyl paraoxon by comparison of the i.r. of the photoproduct and of the authentic sample. The i.r. peaks were developed at 1266

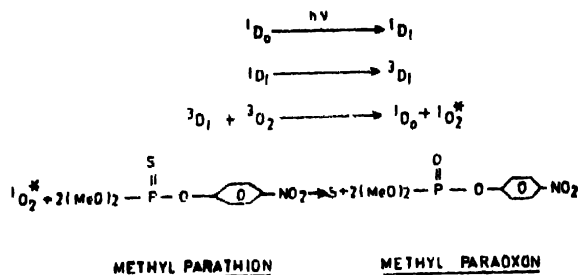


in the photoproduct (methyl paraoxon) which is absent in the authentic sample, while the i.r. peak at 824 cm⁻¹ which is



sample (methyl parathion) is absent in the photoproduct. The fact that the blackening of lead acetate paper⁴ is not observed in the photo-product (methyl paraoxon) as compared to the methyl parathion itself confirms the absence of sulphur in the photoproduct. The use of DABCO scavenger confirms the

participation of singlet oxygen⁷. The possible mechanism of the reaction is



The authors are grateful to M/S Pesticides India, Udaipur for the gift of methyl parathion and to the Department of Science and Technology, Government of India, New Delhi for financial support. Thanks are also due to Principal, MLV Govt. College, Bhilwara for providing facilities for this work.

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Revised : 9 April, 1987.

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Physicomathematical aspects of the stability of cell wall

The cell membrane expands in an orderly manner to accommodate cell growth. Instability of deformation of cell wall is associated with the growth of the cell. The cell-membrane division is a biomechanical instability problem¹. As the radius of an animal cell (supposed to be spherical) increases, wall thickness decreases. For large strains due to time-dependent pressure $p(t)$, the wall of the cell membrane expands. There is an internal pressure at which dimensional instability occurs. The cell membrane is highly extensible^{2,8}. The protein layer is cross-linked, so it has rubber-like elasticity and does resist changes of shape. Assuming the incompressibility of the material, one gets

$$\lambda_r \lambda_\theta \lambda_\phi = 1, \quad (1)$$

where $\lambda_r, \lambda_\theta, \lambda_\phi$ are the components of stretches. Using the uniaxial stress-strain relations, one gets for the pressure

$$p = \frac{2\delta}{R} \sigma_\theta = \frac{2\delta_0}{R_0} \lambda_\theta^{-3} \sigma_\theta(\lambda), \quad (2)$$

where $\sigma_\theta(\lambda)$ is the stress in terms of the stretch λ , R the radius of the cell subjected to an internal pressure p , δ the wall thickness and the suffix 0 indicates the initial values. The limit of stability of the growth of a cell is given by

$$\frac{dp}{d\lambda_\theta} = \frac{2\delta_0}{R_0} \frac{d}{d\lambda_\theta} \left[\lambda_\theta^{-3} \sigma_\theta(\lambda_\theta) \right] = 0. \quad (3)$$

If the increase of $\sigma_\theta(\lambda_\theta)$ is faster than with λ_θ^3 , stability of the deformation can be maintained but when $\sigma_\theta > \sigma_F$ (where σ_F is the critical stress), instability will result. If the cell wall is assumed to be of neo-Hookean in behaviour and incompressible and if P be the internal pressure, μ the shear modulus and λ_a the value of λ at the inner wall at $r = a$, the equilibrium will be stable when P/μ increases with increasing λ_a and unstable when P/μ decreases with increasing⁴

λ_a, λ_a corresponding to $(P/\mu)_{max}$ is the transition point and must be considered as a point of unstable equilibrium.

The movement of ions (but blocks any transfer of macromolecules) through the semi-permeable membrane of a cell is influenced by the electrical potential which is set up when ion-charge gradients are created. Concentration gradients would cause K to move out of the cell and Cl to move inward; this exchange disrupts the charge equilibrium and a potential would result, opposing further movement^{6,7}. It has been shown⁷ that the greater the concentration of protein within the cell, the greater will be the differential distribution of electrolyte. The membrane potential level may have a significant regulatory influence on metabolic preparations for cell division⁸ and hence influence the stability. (The electrical properties of the cell surface change during the cycle)⁹.

The cell wall of a plant cell is typical and composed of a relatively rigid substance. The walls are neither perfectly nor infinitely elastic¹⁰ so that the change in cell size is a complex function of the pressure. The mechanics of plant-cell wall extension is based on the analogy of the cell wall with a membrane structure made of material capable of large non-linear deformations¹¹. Mathematical analyses of such membrane structures show that there is, generally, a critical internal pressure at which dimensional instability occurs. Individual plant cells have non-equal enlargements in all directions during growth and hence the distribution of stresses on the cell is not uniform. A plant cell, if started out spherical, soon loses its shape. (Of course, there are very few plant cells which are spherical).

Plant cells generally have a large number of vacuoles. They develop pressures up to $5 \times 10^5 \text{ Nm}^{-2}$ to $15 \times 10^5 \text{ Nm}^{-2}$. The cells do not burst under such pressure due to extraordinary strength of the cell wall. The vacuoles coalesce when they are within

a certain critical distance¹². If the vacuoles are simply assumed to be spherical and if S denotes the tension, the energy liberated after coalescence of the small vacuoles is given by

$$E = 4 \pi S [\sum r_i^3 - R^3], \quad (4)$$

where $R = (\sum r_i^3)^{1/3}$ is the radius of the resultant vacuole, $i = 1, 2, 3, \dots$

If the vacuoles are assumed to be of the same radius r , the rise in temperature of the cellular fluid after coalescence is

$$T \simeq \frac{3S}{J} \left(\frac{1}{r} - \frac{1}{R} \right), \quad (5)$$

J = mechanical equivalent of heat. Taking $R = 15 \times 10^{-8} \text{ m}$, $r = 0.3 \times 10^{-8} \text{ m}$, $S = 0.2 \times 10^{-8} \text{ Nm}^{-1}$, one gets $T \simeq 0.47^\circ \text{C}$. A temperature change of this magnitude is used to activate a plant cell.

It is assumed that the cell is spherical, stress distribution is uniform and the wall deformation is elastic¹³. The cell expands in the radial direction and one has for the stresses¹⁴

$$\sigma_\theta = \sigma_\phi = \frac{1}{2} \frac{pR}{\delta}. \quad (6)$$

Beyond the limit $\sigma_\theta = \sigma_\theta^*$, small strain theory is not applicable, since the decrease of the wall thickness with radial expansion cannot be ignored. From the equilibrium condition, one gets

$$\sigma_\theta^* 2\pi R_0 \lambda_\phi \delta_0 \lambda_\theta^{-2} = p_0 (R_0 \lambda_\theta)^2 \pi, \quad (7)$$

the pressure p_0 required to sustain stationary flow is

$$p_0 = \bar{p} \lambda_\theta^{-3} < \bar{p}^* (\equiv 2\delta_0 \sigma^* / R_0) \quad (8)$$

and, therefore,

$$\frac{dp_0}{d\lambda_\theta} = -3\bar{p} \lambda_\theta^{-4} < 0, \quad (9)$$

which indicates a condition of unstable equilibrium when the critical pressure \bar{p}^* is attained. Since the radius of a growing

plant cell is a complex function of the stress σ , the instability may not arise at the yield limit σ^* , since the stresses may increase beyond the limit. If one introduces the logarithmic strain measures $\epsilon_{\theta L} = \ln \lambda_{\theta} = \ln(R/R_0)$ and $\epsilon_{rL} = \ln \lambda_r = \ln(\delta/\delta_0)$, the condition of volume constancy of the wall $4\pi R^2\delta = \text{constant}$ or $d(R^2\delta) = 0$ and therefore $2 \ln \lambda_{\theta} + \ln \lambda_r = 0$ or $\lambda_r \lambda_{\theta}^2 = 1$ can be written as

$$\epsilon_{rL} = -2\epsilon_{\theta L}. \quad (10)$$

Therefore, one gets

$$R = R_0 e^{\epsilon_{\theta L}} \text{ and } \delta = \delta_0 e^{-2\epsilon_{\theta L}} \quad (11)$$

and the expression (6) gives

$$p = 2 \frac{\delta_0}{R_0} \sigma_{\theta} e^{-3\epsilon_{\theta L}} \quad (12)$$

Instability will arise if

$$\frac{dp}{d\epsilon} = 0 \text{ or } \frac{d\sigma_{\theta}}{d\epsilon_{\theta L}} = 3\sigma_{\theta}. \quad (13)$$

If a plant-cell wall is considered to be made of Mooney—Rivlin material, the instability pressure is given by¹¹

$$p_c = 4P_0\delta_0\mu/R_0, \quad (14)$$

where P_0 is the pressure number at instability ($\simeq 0.6$), μ is the modulus in Mooney strain energy function, δ_0 the initial thickness and R_0 the initial radius.

The author is indebted to the U. G. C., New Delhi for financial support.

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Report of abnormal gall bladders in *Calotes versicolor* (Daudin) infected by the fluke *Paradistomum orientalis* (Narain and Das)

During a recent investigation, 81% *Calotes versicolor* (Daudin) of Sonari, Jamshedpur were found heavily infected by the fluke *Paradistomum orientalis*¹ (Narain and Das). The fluke was localized in liver and gall bladder of the lizard. In two specimens of the lizard the infected gall bladder was abnormal. In one lizard there were two gall bladders (Fig. 1) measuring 5 mm x 2 mm and 2 mm x 1 mm in size. Both the gall bladders were full of bile and had a common duct for opening into the duodenum. The larger gall bladder had 17 and smaller 10 flukes. In another specimen the gall bladder had become elongated (Fig. 2) measuring 1.6 cm in length and 0.3 cm in diameter. It had 18 flukes in the lumen and was full of bile. In both the specimens the liver was pale in colour though normal in size. The authors believe that abnormal



Fig. 1. Showing two gall bladders (G₁ and G₂) of *Calotes versicolor*.
L=Liver, D=Duodenum.



Fig. 2. Showing elongated gall bladder (G) of *Calotes versicolor*.
L = Liver

gall bladders in *C. versicolor* may be due to accumulation of large number of *P. orientalis*.

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Note on the ovicidal action of diflubenzuron (Dimilin 25 WP) on the eggs of the brinjal leaf beetle, *Henosepilachna vigintioctopunctata* Fabr. (Coleoptera : Coccinellidae)

Phenylurea compounds and their analogues which are referred to as fourth generation insecticides, are anticipated to be of great value in future pest control². Diflubenzuron, 1-(4-Chlorophenyl)-3-(2, 6-difluorobenzoyl) urea, which is marketed as Dimilin 25 WP is an insecticide inhibiting chitin synthesis in the cuticle. Very little or no information is available on the ovicidal action of this compound in India and abroad so far. Hence an attempt was made to study the ovicidal action of Dimilin 25 WP on the freshly oviposited (2-4 h old) and 5-day-old eggs of *H. vigintioctopunctata* Fabr., in the summer season (1986).

Eggs of two age groups (2-4 h and 5-day-old) of the test insect were collected from the brinjal plants (var. Pant Samrat) transplanted in cylindrical glass aquarium (size 30 × 2 cm) covered with muslin cloth and thus the treated eggs were free from the eggs of parasitoids. Different concentrations (ai) of diflubenzuron e.g. 0.0001%, 0.0005%, 0.00075%, 0.001%, 0.0025%, 0.005% and 0.0075% in distilled acetone were applied topically with the help of a micrometer driven syringe and soft camel brush. Each egg received 0.50 µl of acetone solution of varying strengths. For control experiment, only distilled acetone (0.50 µl/egg) was applied. Three replications for each concentration were kept and thirty eggs per replication were treated. Treated eggs were incubated on moist filter paper in petri dishes (size 9.5 cm) at 25 ± 1°C in a BOD incubator. Petri dishes were observed daily upto 10 days and number of eggs hatched were counted in each replication. Eggs that did not hatch were taken as dead. Percent egg mortality was worked out for each concentration and corrected for the mortality in control according to the

formula developed by Abbott¹. In the present investigation the control experiment did not show any mortality in the eggs. The egg mortality data were subjected to probit analysis² and regression equations, LC_{50} values and fiducial limits were worked out for the eggs of both age groups i.e. freshly laid and 5-day-old. The results are summarised in Table 1.

0.00744%, about 7.153 times higher than the LC_{50} value calculated for freshly laid eggs. The results obtained in the present investigation clearly indicated that the sensitivity of the eggs depended on the progress of embryogenesis and dose of insecticide. Five-day-old eggs showed very poor response to diflubenzuron due to complete embryonic development while freshly laid

TABLE 1 : Toxicity of diflubenzuron (Dimilin 25 WP) on the eggs of brinjal leaf beetle, *Henosepilachna vigintioctopunctata* Fabr. a serious insect pest of solanaceous vegetables (summer season, 1986)

Age of the eggs	Conc. (% ai)	No. of treated eggs(n)	No. of dead eggs	Egg mortality (%)	Corrected egg mortality (%)	Regression equation	LC_{50} value (%)	Fiducial limits of LC_{50}
1 : 2-4 h old eggs	0.0002	90	9	10.0	10.0	$Y = 1.928x + 1.111$	0.00104	$m_1 = 0.00132$
	0.0005	90	24	26.7	26.7			$m_2 = 0.00081$
	0.00075	90	39	43.3	43.3			
	0.001	90	44	48.9	48.9			
	0.0025	90	57	63.3	63.3			
	0.005	90	78	86.7	86.7			
	0.0075	90	88	97.8	97.8			
	Control	90	—	—	—			
2 : 5-day-old eggs	0.0002	90	6	6.7	6.7	$Y = 1.964x - 0.641$	0.00744	$m_1 = 0.00970$
	0.0005	90	9	10.0	10.0			$m_2 = 0.00654$
	0.00075	90	18	20.0	20.0			
	0.001	90	21	23.3	23.3			
	0.0025	90	30	33.3	33.3			
	0.005	90	33	36.7	36.7			
	0.0075	90	48	53.3	53.3			
	Control	90	—	—	—			

In case of 2-4 h old eggs the mortality in different concentrations of diflubenzuron varied from 10.0 to 97.8% while in case of 5-day-old eggs, the per cent mortality in different concentrations ranged from 6.7 to 53.3. Perusal of the data (Table 1) reveal that freshly laid eggs were more sensitive to diflubenzuron where the LC_{50} value was very less i.e. 0.00104 per cent. In case of 5-day-old eggs the LC_{50} value was

eggs showed marked response to diflubenzuron. Moore and Taft⁴ reported that the ovicidal action of diflubenzuron may be based on the same process as its larvicidal action i.e. interference with the chitin deposition in the endocuticle.

LC_{50} values of diflubenzuron were worked out for the eggs of *H. vigintioctopunctata* Fabr. of two age groups i.e. freshly laid and 5-day-old and taken as a parameter for the

ovicidal action. The LC_{50} value of diflubenzuron for freshly laid eggs (2-4 h old) was 0.00104% and thus showed marked ovicidal action by inhibiting the chitin synthesis in the embryo of the freshly laid eggs. The calculated LC_{50} value for 5-day-old eggs was about 7.153 times higher (0.00744%) than the value worked out for 2-4 h old eggs and thus showed very poor response due to complete embryonic development.

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Chromosome report for *Anemia schimperiana*

Anemia Swartz is an ancient member of pteridopytes (Schizaeaceae) and enjoyed world-wide distribution in the Cretaceous and early Quaternary¹. But today the genus is represented nearly by 100 species in tropical America and 10 in Africa. *A. rotundifolia* Schrad is the only species so far reported from South India². In the present communication, the occurrence of *A. schimperiana* Presl is reported for the first time from South India and its chromosome count forms the first report in this species.

Materials for the meiotic studies were collected from Yercaud in Tamil Nadu State. The sporangia were fixed in 3 : 1 alcohol-acetic acid and smeared in 1% acetocarmine. The spore-mother cells showed 38

bivalents at metaphase I (Fig. 1). The subsequent stages of meiosis were normal. The present species is found to be diploid on the base number $x = 38$.

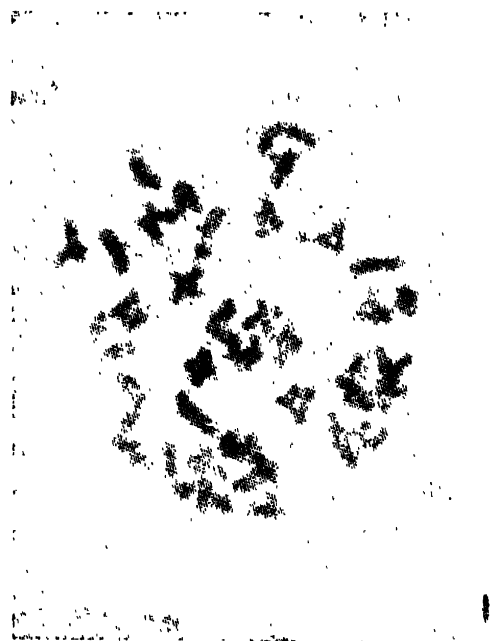


Fig. 1. A Spore-mother cell of *A. schimperiana* showing 38 bivalents at metaphase I. $\times 1125$

Available chromosome counts reveal that *Anemia*, perhaps, is the only genus in ferns reported to have a wide spectrum of ploidy levels in which sporophyte numbers range from $2x$ to $14x$. It is interesting to note that both the South Indian species, *A. schimperiana* of the present study and *A. rotundifolia* reported earlier are diploids.

L. Sankari Ammal is thankful to the University of Kerala for the award of Research Fellowship.

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Anatomical changes of jute stem by yellow mite

Yellow mite (*Polyphagotarsonemus latus* Banks) is one of the major pests of jute. Due to its attack, apical leaves of the plants curl downwards; as the plant sap is sucked by the mite from the ventral surface of the leaves. The size of the affected leaves became smaller and coppery brown in colour¹⁻³. The internode of the affected stem of jute became shortend. Histomorphological studies of affected jute leaves by yellow mite were already worked out⁴. Histomorphological changes of leaves and stems of four different allied fibre crops due to attack of mealy bug were also recorded⁵. Detail work was carried out to find out the histomorphological changes of yellow mite affected jute stem.

In the experimental, one *olitorius* variety of jute JRO 878 was selected for the study as it was highly susceptible to yellow mite⁶. One centimetre long highly infested stem along with one control (without infestation) were taken for studies. Both the stems were kept in F.P.A. solution for 24 hr for fixation. The fixed stems were then left overnight in running tap water for removal of formalin from stem tissues. The tissues were then dehydrated through up grades of alcohol and left overnight in absolute alcohol with two changes in it. The stems were then transferred to xylol for 5 min. The tissues were infiltrated with molten paraffin (60°C) for 1 hr. Sections (8 μ thick) of the stem were cut and stained with alcoholic Bismark Brown solution. Permanent preparation for microscopical examination was done using Canada balsam.

The diameter of the infested stem was generally reduced. The epidermal cells, collenchyma and metaxylem were reduced in volume while in normal-unaffected stem there was no reduction in size and volume of the above cells (Fig. 1) although the number of angular collenchyma and isodimetrical par-

enchyma cell layers in the cortex remained unchanged. The vacuoles of the affected stem became smaller and the cortical area



Fig. 1. Transverse section of stem of normal jute plant. C = cortex; E = epidermis; P = pith; V = vacuole and Xy = xylem.

was somewhat condensed. As a result, the squeezing cells of collenchyma were invaded by the vacuoles. In the normal stem, the cortical cells were regular and compact in arrangement and without dissolution of cell walls while in case of infested stem some of the cortical cells were disorganised with the dissolution of cell walls. In the normal unaffected stem the vacuolar tissues, particularly both secondary xylem and phloem were arranged in a regular ring-like structure and the ring-like formation was disrupted badly in case of affected stem. As a result, the derivatives of secondary phloem and xylem was not formed normally. Cells were elongated in the metaxylem region. The collenchyma bands were continuous except in the

region pervaded by the vacuoles. Condensation and compression were observed in all types of tissues of the affected stem. The vacuoles in the pith were also reduced or compressed (Fig. 2). The pith parenchyma was also compressed. The dense content of



Fig. 2. Transverse section of stem of yellow mite infested jute plant. C=cortex; P=pith; V=vacuole and Xy=xylem.

tanniniferous cells was also reduced and thereby the vacuolar nature of the cells were more apparent. From the above observation, it would appear that all such histomorphological changes in jute stem brought about by the infestation of yellow mite may be due to some endogenous metabolic changes resulting in the disruption of the cellular organisation in general and malformation of some primary tissues, in particular the reduction of tanniniferous cells (of course subject to further study in this line).

Thanks are due to Dr. R. K. Maity for his help. Thanks are also extended to Mr. S. K.

Pradhan, Head of Division of Entomology, J.A.R.I. for encouragement.

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Genetic aspect of capacity of colonization of *Blechnum orientale*

Blechnum orientale (Linn.) occurs commonly in open places of Rangpo and Namthang of Sikkim Himalayas at low and high altitudes. It is the only species of the genus in the area without any prolific growth. In Namthang, it is sparingly found in roadside but in Rangpo it is rather abundant. The plant is characterised by the possession of the elongated sori scattered over the secondary vein parallel to the midrib of the pinnae. The sori are protected by a flap-like indusium opening on the costal side.

The spores are collected from both the sources mentioned above and stored in a desiccator and surface-sterilized with 2% sodium hypochlorite solution before sowing on 50 ml of autoclaved sterilized inorganic

nutrient medium¹ gelled with 1% agar at pH 5.8 in Petridishes. The plates were maintained at $24 \pm 2^\circ\text{C}$ under continuous white fluorescent illumination at an intensity of 2500 lux in a culture room. When the prothalli became cordate with the formation of notch, they were randomly selected and transferred to fresh solidified nutrient agar medium to yield three kinds of population, namely isolate, pair and composite. Crossing programme for the gametophytes is mentioned below :

- (A) Consisted 25 singly isolated gametophytes from Namthang.
- (B) Consisted 25 singly isolated gametophytes from Rangpo.
- (A \times A) Consisted 25 pairs, i.e. 50 gametophytes both from Namthang.
- (B \times B) Consisted 25 pairs, i.e. 50 gametophytes both from Rangpo.
- (A \times B) Consisted 25 pairs, i.e. 50 gametophytes each plate contained two gametophytes, one from Namthang and one from Rangpo.
- (A' \times B') Consisted of 25 composite cross cultures ; each plate contained 20 gametophytes of which 50% was from Namthang and remaining from Rangpo.

At the sexual stage of the gametophytes, the cultures were watered twice weekly with distilled water to facilitate fertilization and sporophyte formation. Unwatered gametophytes never produced sporophytes, proving the absence of apogamy in the taxon. Despite watering the gametophytes that failed to produce sporophyte were examined morphologically for the presence of male and/or female gametangia and indication of fertilization by mounting them in Hoyer's medium² after staining with acetocarmine.

The monolete spores germinated in four days after sowing. On the cordate prothalli, antheridia were produced after 10 days and thereafter the gametophytes became bisexual. Antheridia were borne adjacent to the rhizo-

ids and the archegonia below the apical notch orientating their necks away from antheridia (Figs. 1 and 2). Details of the sex expression in random samples are shown in



Figs. 1-3 : (1) Mature cordate gametophyte bearing antheridia and archegonia ($\times 10$) ; (2) Antheridia and archegonia ($\times 400$) ; (3) Gametophyte with sporophyte ($\times 10$).

Table 1. When archegonia matured, most antheridia were spent up so that a functional male and a female stage were evident along with a transient hermaphroditic stage when selfing could take place. First sporophytic leaf initiation started in composite culture

TABLE 1: Periodicity of changes in sex-ratio in a stock culture of 20 gametophytes in *B. orientale*

Days after sowing	Number of gametophytes			
	Sterile	Male	Female	Hermaphrodite
45	20			
50	20			
55	16	4		
60	12	8		
65	10	8		2
70	4	6		10
75		3		17
80				20
85			8	12
90			10	10
95			16	

after 80 days of germination, while the same in pair and isolate culture needed 87 and 90 days. The percent sporophyte production was highest in composite followed by A × B, A × A and B × B pair cultures (Table 2) which indicated that this species took to cross breeding due to the accumulation of recessive sporophytic lethals in its gene pool in the absence of incompatibility barrier²⁻⁵. The sporophyte production was 95.5% in composite, 77.4% in pair and 12% in isolates. The last figure supported the possibility of selfing though to a much reduced extent.

Sporophyte production thus was highest in composite and lowest in isolate cultures. In the pairs since both prothalli could have a common parental origin, there existed a fair chance of recessive sporophytic lethals to become homozygous. This will explain lesser number of the average sporophytic yield in pair populations. So the breeding pattern of this taxon suggests that the parental sporophytes were heterozygous for recessive sporophytic lethals. Persistence of intragametophytic mating system in lowest ebb, as reflected by the production of a

TABLE 2: Breeding test for *B. orientale* populations: Percentage of gametophytes not producing sporophytes in isolates, pairs and crosses

Locality	Population of gametophytes	No. of gametophytes studied	No. of gametophytes produced sporophytes	% of gametophytes not produced sporophytes	Mean of % of gametophytes not producing sporophytes
A	Isolate	25	4	84	A
B	Isolate	25	2	92	B
A × A	Paired	25 × 2 = 50	35	30	A × A
B × B	Paired	25 × 2 = 50	38	26	B × B
A × B	Cross	25 × 2 = 50	44	12	A × B
A' × B'	Composite	20 × 20 = 400	382	4.5	

88%

22.6%

4.5%

reduced number of selfed sporophytes may indicate that the native areas were initially colonized by homozygous sporophytes. Gradual genetic alterations had directed inbreeding to cross breeding in course of time. And along with adaptation to cross-breeding, genetic diversity in the population increased. During colonization of a new habitat, if the germinating spores are sufficiently apart from each other, inter-gametophytic mating will be impossible and only a successful intra-gametophytic selfing can help the species to hold on there. This seems to have been the case with *B. orientale* whose sexuality had transformed from intra-gametophytic selfing to almost obligatory intergametophytic crossing. Whenever multispore invasion was possible, small communities of plants came up leaving wide gaps between populations due to invasion by single spores or no invasion. This will probably explain the restricted patchy distribution of populations against a more evenly distributed one. This result may be ascribed to the extent of genetic load present in the taxon.

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Production of proteases by certain keratinophilic fungi

The term 'proteases' refers to a mixture of proteolytic enzymes, which may include

proteinases and peptidases¹. It is well known that fungal proteinases are active against a wide variety of proteinaceous substrates². The hydrolysing action of proteolytic enzymes plays an important role in the preparation of various enzymatic products, which have a wide application in the fields of brewery³, textiles⁴, dairy⁵, pharmaceutical⁶ and leather industries during the process of dehairing and bating of skins and hides⁷. The predominance of a particular type of proteinase may depend upon the nature of the growth medium that is employed⁸.

The evaluation of the synthesis of proteolytic enzymes was performed by four species of keratinophilic fungi under test i.e., *Nannizzia incurvata* Stockdale (+) and (–) strains, *Malbranchea aurantiaca* Sigler & Carmichael and *Botryotrichum keratinophilum* Kushwaha and Agrawal. Recently, the role of proteolytic enzymes produced by these fungi in degradation of native keratin has been discussed⁹. During the present study, an effort is made to determine the suitable conditions for the maximum production of proteases by these keratinofers.

The culture medium containing glucose—10 g, gelatine—10 g, K₂HPO₄—1 g, MgSO₄.7H₂O—0.5 g per 1 litre of distilled water at pH 6.9, was prepared. 30 ml aliquot was dispensed into each 150 ml Erlenmeyer flask. After autoclaving at 15 lb pressure for 15 mts, all the flasks were inoculated with an inoculum disc of 6 mm diameter obtained from 8 days old culture of the test fungus. The flasks were incubated at 28°C and harvested at desired intervals by filtering through pre-weighed filter papers. The culture filtrates were assayed for extra cellular protease production by spectrophotometric method as explained by Meyers & Ahearn¹⁰. The reaction mixture containing 0.5 ml of culture filtrate, 0.5 ml of citrate buffer (pH 6) and 1 ml of 1% casein solution dissolved in the citrate buffer, was incubated at 35°C for 20 mts. The

reaction was stopped by adding 4 ml of 5% Trichloroacetic acid (TCA). After 1 hr, the solution was filtered through Whatman No. 1 filter paper. One ml of filtrate was mixed with 5 ml of 0.4 M Na_2CO_3 solution and then 0.5 ml of phenol reagent was added. The amount of tyrosine liberated in the filtrate at 660 nm wavelength was calculated by comparing the values with that of a standard curve of tyrosine. Each value was multiplied by 6 (since the total volume of the filtrate was 6 ml) and divided by 20 in order to get the amount liberated per minute, and the values were shown in Table 1. One unit of enzyme activity was defined as the amount of enzyme liberating 1 μg of tyrosine per minute under the defined conditions¹¹. A perusal of data (Table 1)

In order to know whether the enzyme is of constitutive type, another medium consisting of glucose—10 g, asparagine—4 g, K_2HPO_4 —1 g, $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ —0.5 g per one litre of distilled water was taken in another set of flasks. After autoclaving, the flasks were inoculated with inoculum disc of 6 mm diameter of the test fungus and the flasks were incubated at 28°C for 20 days. The enzyme samples were prepared and assayed in the same way as described earlier. All the test fungi showed fair growth in glucose-asparagine medium also, which lacked protein source. Enzyme activity was observed even when protein was lacking in the medium, indicating that the enzyme produced is of constitutive type. However, enzyme production in this case was quite

TABLE 1: Protease production by keratinophilic fungi at different incubation periods in glucose-gelatine medium

Days of incubation	Units of enzyme produced*			
	<i>N. incurvata</i> strain (+)	<i>N. incurvata</i> strain (—)	<i>M. aurantiacum</i>	<i>B. keratinophilum</i>
8	3.45	4.2	3.9	2.7
10	5.025	7.8	7.5	3.375
15	6.825	9.075	7.5	6.825
20	10.275	12.6	9.45	14.1
25	9.525	10.65	8.4	10.125

*One unit is defined as the amount of enzyme liberated 1 μg of tyrosine per minute.

shows that most of the test fungi could produce extracellular protease enzymes which could liquify gelatine varying in the degree of their activity. The enzyme production increased with the increase in the incubation period from 8 to 20 days. However, after 20 days there was a sudden decline in the enzyme activity. The optimum incubation period for the maximum enzyme activity was found to be after 20 days at 28°C.

less when compared to that of glucose gelatine medium (Table 2).

To see the effect of some carbon sources on protease production, the glucose source in the selected basal medium (Glucose gelatine medium) was replaced by test sugars such as sucrose, lactose and maltose. The culture filtrates after incubation period of 20 days were obtained and after centrifuging, the samples were used for enzyme assay. Strickingly, in most of the cases, the synthe-

TABLE 2: Protease production in different culture media after 20 days of incubation

Organism	Enzyme Units*	
	Glucose-gelatine medium	Glucose-asparagine medium
<i>N. incurvata</i> strain (+)	10.275	05.700
<i>N. incurvata</i> strain (—)	12.600	02.775
<i>M. aurantiaca</i>	09.450	03.900
<i>B. keratinophilum</i>	14.100	02.700

*One unit is defined as the amount of enzyme liberated 1 µg of tyrosine, per minute.

ved from the University Grants Commission, New Delhi.

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Received : 8 May, 1986.

Revised : 27 July, 1987.

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TABLE 3: Effect of different carbon sources on protease production after 20 days of incubation

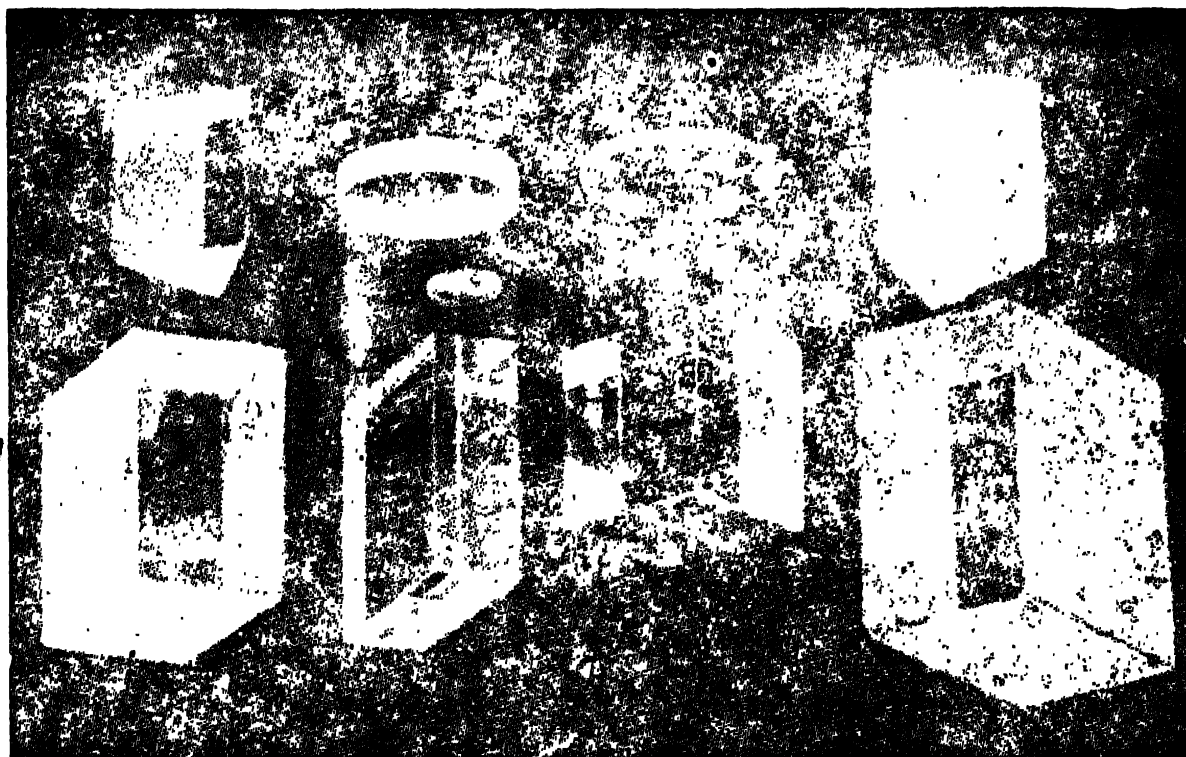
Carbon source	Units of enzyme produced*			
	<i>N. incurvata</i> strain (+)	<i>N. incurvata</i> strain (—)	<i>M. aurantiaca</i>	<i>B. keratinophilum</i>
Glucose	10.275	12.6	9.45	14.1
Sucrose	3.3	3.675	3.3	4.2
Lactose	4.05	3.45	5.1	4.575
Maltose	2.775	1.35	3.375	2.625

*One unit is defined as the amount of enzyme liberated 1 µg of tyrosine per minute.

sis of enzymes was maximum in the medium containing glucose. The decline in the enzyme activity in various carbon sources was in the order of lactose, sucrose and maltose (Table—3). The promotary activity of glucose was also reported during the protease production by other fungi^{12,13,14}. Further, it was reported that of all the carbon sources, the dermatophytes have a common preference for carbohydrates and exhibit best growth in presence of glucose¹⁵. The present investigations also confirm the same observation.

The authors thank the Head of the Department of Botany, University of Saugar, Sagar, for facilities and the senior author acknowledges the financial assistance recei-

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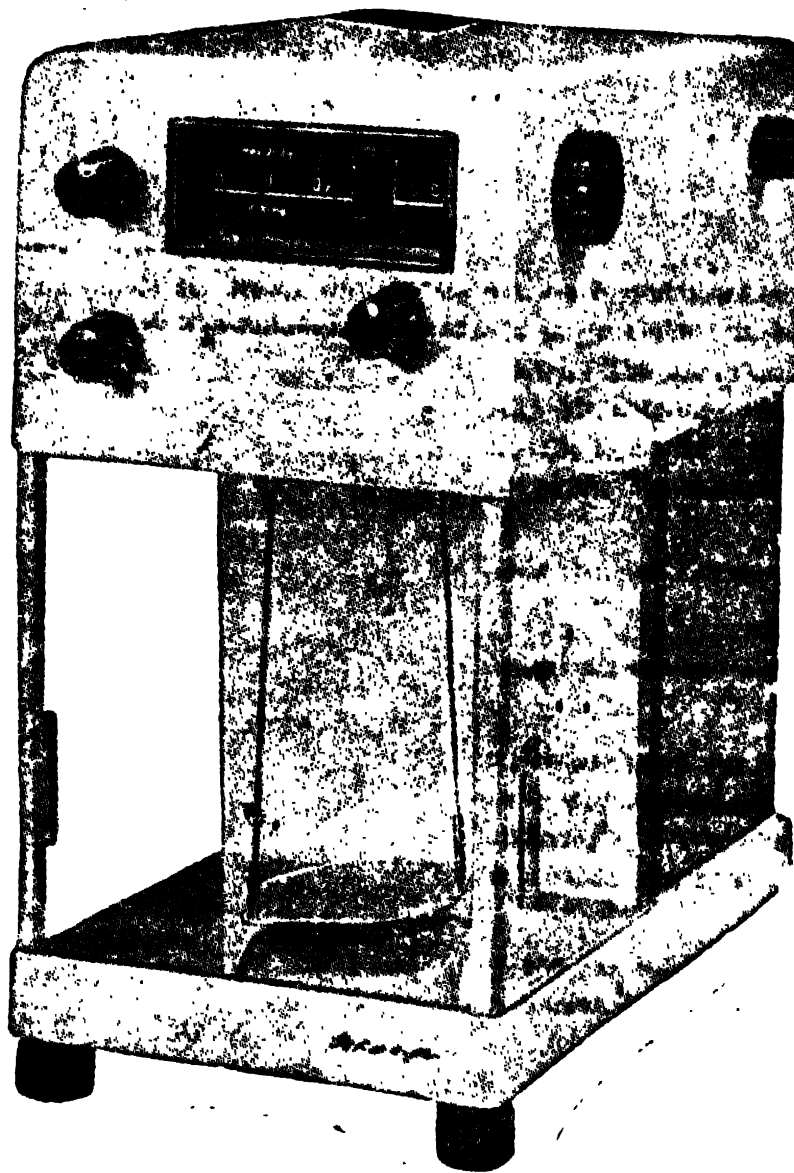
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SEPTEMBER 1987 □ VOLUME 53 □ NUMBER 9 □ SCINAL 53(9) 259-290 (1987)

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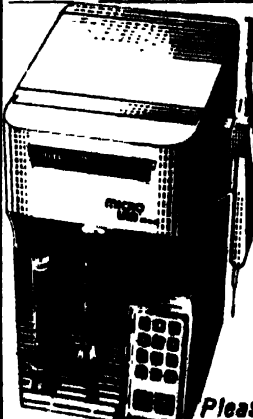
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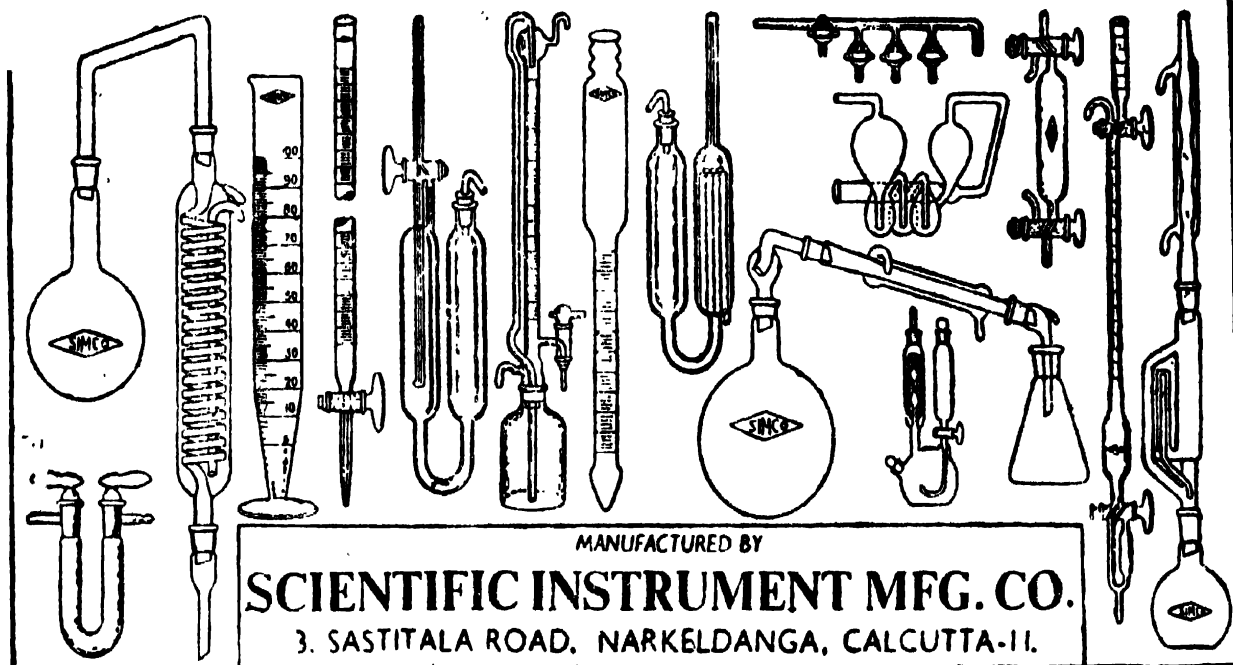
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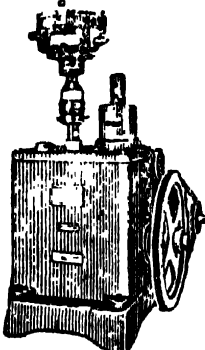

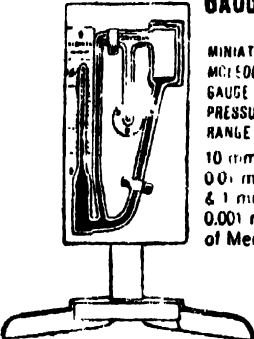
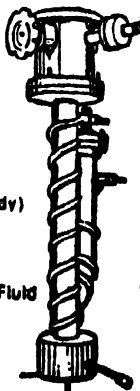
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SCIENCE & CULTURE

September 1987/Volume 53/Number 9

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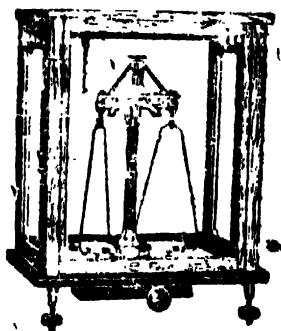


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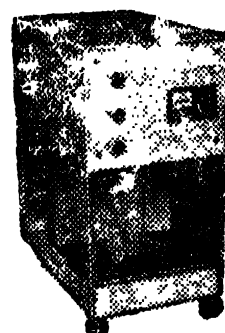
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SUPERCONDUCTIVITY MIGRATES TO WARMER TEMPERATURES

B. B. BALIGA*

SINCE the beginning of 1987, the world of physics is greatly excited with new discoveries in the superconducting materials. It was way back in 1911, that Kammerling Onnes discovered the phenomenon of superconductivity at the University of Leyden in Holland. The discovery became possible as he had succeeded, three years prior to this momentous discovery, in liquifying helium, attaining the lowest possible temperature (4.2 K) at that time. Absolute scale of temperature is also called the Kelvin scale and temperature measurements on this scale are depicted with the letter K. On this scale the freezing point of water is 273 K.

Superconductivity is that characteristic of the material in which its electrical resistance falls to zero and the current flows without any loss. As is conventional that everything starts freezing as the temperature is lowered, Kammerling Onnes wanted to see that the loosely bound current carrying electrons in the metal frozen at the lattice sites, reducing the electrical conductivity to zero. He chose mercury, as his metal to be tested, as it could be obtained in very pure form (by multiple distillation) and contrary to his expectations found that the conductivity of the substance shoots to infinity. Kammerling Onnes was awarded Nobel Prize

in the year 1913. For a long time, this total loss of electric resistance below a critical temperature, T_c , was the only characteristic of a superconductor. Then in 1933 Meissner discovered that when a superconducting material is kept in a magnetic field above the transition temperature and cooled below T_c , i.e. when the substance becomes a superconductor, it expels the magnetic field present in its interior. The Meissner effects added a new dimension to the phenomena of superconductivity.

This property of the superconductors to carry large currents became the natural choice for making electromagnets to generate intense magnetic fields. However, the world had to wait till 1958 for a technological breakthrough when a niobium compound was found to be able to carry large currents and also withstand high magnetic fields produced. Yet liquid helium was required as this compound had a T_c of 10 K. Then started a race to find different compounds of niobium which gave higher T_c . The highest one in that series was given by an alloy of niobium and germanium at $T_c = 23$ K. However, this was too brittle a substance to make into coils for magnets.

A better understanding of the supercon-

ductivity phenomena came through the work of Bardeen, Cooper and Schrieffer (BCS) in 1957 who explained its mechanism in terms of electron pairs. This was an important breakthrough after almost fifty years and fetched a Nobel Prize for Bardeen (in 1972). This was followed by the work of Brian Josephson (1962) who discovered an interesting effect at the superconducting junction and which found many technological applications. However, the phenomena clung closely to the liquid helium temperature. Josephson was awarded the Nobel Prize in 1973.

The outstanding problems in superconductivity physics, ever since its discovery in 1911, was raising the critical temperature (T_c) for superconductivity to 30-40 K so that superconducting systems could be reliably run using liquid hydrogen or neon. In the 50s Matthias and Hulm of Bell Laboratories carried out extensive searches for superconductivity in transition metal alloys and compounds. This helped Kunzler to discover the superconducting materials NbTi and Nb₃Sn which remain superconducting in the presence of high magnetic fields. In the sixties, Geballe and Matthias raised the T_c to above liquid Hydrogen temperature (20 K). This was the beginning of the superconducting magnets. Today the Tevatron in Fermilab uses this technology and there are a number of accelerators around the world which employ superconducting magnets. In recent times, magnetic resonance imaging devices are also engaging superconducting magnets. The highest T_c (23.2 K) at which superconductivity was found in this type of compounds (as already stated) was Nb₃Ge by Gaveler of Westinghouse Research Laboratories in 1973. Scientists at Westinghouse were convinced that T_c could not be increased in these compounds of AIS series. (Crystallographic symbol of compounds with composition

Nb₃X or V₃X where X is a non-transition element).

In the same year (1973) Johnston of the University of California, San Diego discovered superconductivity in LiTi₂O₄ at a temperature of 13 K, followed by Sleight of Dupont who observed superconductivity at the same temperature in BaPb_{1-x}Ba_xO₃. Though these discoveries did not raise the transition temperature, these oxides showed some anomalous features. The most notable one was their critical temperatures which were much higher than what would have been expected from their electron densities. Matthias and Batlogg had predicted at that time that these oxides might provide an alternative route to high values of T_c . However, their hopes were not realised for many years, as all the excitement at the time was concentrated on the discovery of a novel type of superconductivity in f-electron systems. These are compounds and alloys of rare earths and actinides with partially filled f-electron shells.

The superconducting phenomena that occurs in f-electron materials are of two kinds. According to Maple (*Phys. Today*, March '86). "In the first type, there are two distinct interpenetrating systems of electrons, a set of localised electrons and a set of itinerant electrons. The localised f-electrons carry magnetic moments while the itinerant electrons are responsible for the superconductivity which is the usual kind involving pairs of electrons...". The novelty of the superconducting phenomena of the first kind arises "from the magnetic interaction between the moments and the spins of the conduction electrons and the magnetic moments of the localised f-electrons". In the second type of superconductive material, there is a single band of electrons consisting both the itinerant and localised f-electrons, the electrons near the Fermi level having very large effective masses, "in some instances

approaching several hundred times the mass of a free electron ... The observation of superconductivity in these heavy electron materials has generated an enormous amount of excitement because the superconductivity was unexpected, has anomalous character ...".

Muller, at IBM, Zurich, resumed the search for high T_c superconductivity in metallic oxides in early 1986 along with Bednorz. Their first paper discussed the synthesis of $Ba_xLa_{1-x}Cu_5O_{8-y}$ and its electrical resistivity for $x=1$ and 0.75. They concluded, "In the concentration range investigated, compounds of the Ba-La-Cu-O systems are metallic at high temperatures ... samples annealed near 900°C under reducing conditions show features associated with an onset of granular superconductivity near 30 K. "Thus superconductivity above 30 K was discovered by well planned motivated research. When Takashige of University of Tokyo joined this group in the summer of 1986 they studied the crystal structure of the superconducting phase in Ba-La-Cu-O system and obtained further evidence of superconductivity in magnetic susceptibility measurements. Their sample contained three phases. $La_{1-x}Ba_xCuO_{8-y}$ with perovskite structure. $La_{2-x}Ba_xCuO_4$ with layered perovskite structure of the K_2NiF_4 type and CuO. The tetragonal K_2NiF_4 type structure was found to be superconducting.

At the annual meeting of the Material Research Society at Boston in December (1986) Chu of University of Houston presented a paper on producing homogeneous specimens of $BaPb_{1-x}Bi_xO_3$ and towards the end presented some resistivity data on Ba-La-Cu-O systems which supported the unusual superconducting properties of these material obtained by the Zurich group. Kitazawa of the University of Tokyo also reported on his group's experiments in Ba-La-Cu-O systems from both magnetic susceptibility and resistivity measurement point of view. They had

obtained single phase $Ba_xLa_{2-x}CuO_4$ with K_2NiF_4 structure and a specimen with $x=0.15$ had exhibited zero resistivity at temperatures as high as 23 K. Before the year ended there were three independent reports from the University of Tokyo, AT and T Bell Labs and the Institute of Physics in Beijing, that Strontium substituted for Barium in the class of oxides studied by Bednorz and Muller can raise the T_c upto 40 K. In the last week of December Chu's group at Houston reported onset of superconductivity at temperature upto 59 K in Ba-La-Cu-O systems under a pressure of 12 K bar.

With these exciting reports week after week in the momentous year of 1986, researchers in superconductivity dropped every other problem they were working on and took up the study of new oxide superconductors. As these oxide superconductors are easy to synthesize many third world countries also joined the race.

Then on 16th February, the National Science Foundation announced in the press that a team of experimenters from the University of Alabama in Huntsville and Chu's group at Houston have observed the onset of superconductivity at temperatures as high as 92 K. The eagerly awaited paper of the Alabama-Houston group in March 3 *Physical Review Letters* did not reveal the chemical composition of the compound as per the advice of their patent attorney. The first sentence in the abstract reads : "A stable and reproducible superconducting transition between 80 K and 93 K has been unambiguously observed, both resistively and magnetically in a new Y-Ba-Cu-O oxide compound system at ambient pressure." This sentence was assuring to the readers that genuine superconductivity has been observed as there were cases in the past when anomalous decrease in electrical resistivity were mistaken for superconductivity.

Simultaneously with these publications, People's Daily of China (Feb. 27) announced

the observation of superconductivity by a Chinese group at temperatures upto 100 K in an oxide of Yttrium, Barium and Copper. On 27th February the *Physical Review Letters* received a paper from the scientists at Bell Communication Research (Bellcore) entitled "Superconductivity at 90 K in multi-phase oxides of Y-Ba-Cu. Hectic activities started in many laboratories to determine the composition and structure of the superconducting phase in the multi-phase Y-Ba-Cu-O. Suddenly superconductivity above 90 K seemed to be a very common phenomenon.

The climax of the excitement about high T_c superconductors was witnessed during the March (1987) meeting of the American Physical Society on Condensed Matter Physics. The organisers had made a four line announcement in the March Bulletin: 'Special panel discussion of the Division of Condensed Matter Physics. High T_c superconducting materials, Trainon Rendezvous.' But this was enough to attract the attention of thousands of physicists who crowded the corridors of New York Hilton late in the afternoon of 18th March. The doors of the Rendezvous Trainon Ballroom were opened at 6.45 pm for the 7.30 pm panel discussion session. The 1140 seats were filled up in minutes and hundreds of physicists stood in the aisle patiently for the session. Many more watched the monitors placed in the lobbies.

There was thunderous applause (see *Phys. Today*, April and May 1987) when Neil Ashcroft the Chairman of the Division of Condensed Matter Physics of the American Institute of Physics (APS) introduced the members of the first panel—Karl Alex Muller (IBM Zurich) Shoji Tanaka (Univ. of Tokyo) Paul C. W. Chu (Univ. of Houston) Zhongjian Zhao (Institute of Physics, Beijing) and Bertram Batlogg (AT and T Bell Laboratories). Ashcroft had planned, after discussion with the members of the Division's executive committee, to have a discussion

period following the panel discussion in which anybody would have the opportunity to report results. It turned out to be a formidable challenge for the APS officers and officials. The session lasted for almost eight hours with 53 presentations. "APS has made available a videotape of the 53 presentations made during the evening session on high T_c superconductivity. Six hours long, the videotape is a complete recording of all the speakers at the session, includes all the slides and graphs presented. The tape has been edited to remove long pauses between speakers, and speakers and their institutions are identified in titles. Questions from the audience and replies are also included". This marathon session is a record in the living memory of the APS.

India joined the race soon after the announcement of Houston results. Laboratories at Bangalore, Madras, Delhi and Bombay, where superconductivity was traditionally studied, diverted their attention to the new activities. India's well known solid state chemist, the director of the Indian Institute of Science, Bangalore immediately snatched the opportunity and made a systematic programme to study various rare earth ceramic compounds and to identify and isolate superconducting phase. In a very short time his group prepared more than 400 such compounds and repeated with confirmation, Houston experiments and reported improvement. In the abstract of their paper in *Nature* (30 April, 1987) they claim. "We have studied various compositions of $Y_{3-x}Ba_{5+x}Cu_6O_{14}$ and now report the isolation of the pure oxide phase responsible for high T_c superconductivity. This oxide has the composition $Y_{0.33}Ba_{0.67}CuO_{2.33+\delta}$ with a oxygen defect perovskite structure. The pure oxide shows the onset of superconductivity at 120 K attaining zero resistance at 87 K. It also

exhibits the highest Meissner effect of all the high T_c superconductors."

The Madras group consists of scientists from Indian Institute of Technology (IIT) headed by Prof. G. V. Subba Rao of the Material Science Research Centre and those from the Indira Gandhi Centre for Atomic Research at Kalpakkam lead by Dr. T. S. Radhakrishnan of the Material Science Laboratory. They prepared new alloys numbering more than 50 based on the combination of Barium Copper Oxygen systems with rare earths. They developed some devices for quick tests of superconductivity. The four probe resistance test is for confirmatory evidence for superconductivity, beside the sensitive apparatus of the Low temperature laboratory could record the exact transition temperature of the sample. The group is equipped to make pellets, discs and spheres from superconducting materials and they are trying to draw the sample into wires. Even though the scientists in the southern states of India are poised for new discoveries, with balanced approach to the problem, with right attitude and suitable test devices and equipments, they are harassed by the erratic electric supply and water shortage, frustrating some of their enthusiasm.

The Delhi group at the National Physical Laboratory is headed by Dr. A. V. Narlikar which was inspired by synthesizing single phase samples of 1:2:3 composition that is $Y_1Ba_2Cu_3O_{9-y}$ with a T_c of about 90 K and a transition width of 2 K. In an article in *Science Today* (August '87) Narlikar writes in first person. "Several quaternary systems formed with different heating schedules were studied. Many of these samples containing Ca, Sr and Cr showed sharp resistance drops, sometimes by more than 55 per cent starting well above 0°C (273 K). In some samples the onset temperature for such a drop was found to be consistently around 27°C (300 K). The sample also contained the 1:2:3

phase as revealed by x-ray diffraction studies". According to Narlikar, in multi-phase systems the most critical test for superconductivity is through the study of inverse a.c. Josephson effect which can unambiguously establish the presence of superconducting regions. "A systematic study of the induced voltage as a function of temperature revealed that in many samples superconducting weak links persisted upto temperatures as high as 230 K than just 90 K. Interestingly in samples which have shown partial resistance drop starting around room temperature, the inverse a.c. Josephson effect was observed upto temperatures 15°C to 26°C, corroborating the onset temperature of resistance drop found for the above samples. Clearly, these samples contain a phase which presumably remain superconducting upto room temperature". They have yet to identify and isolate that high transition temperature superconducting phase.

It was common in the western press where claims and counter claims of high temperature superconductors above > 200 K were made for a couple of months since the first announcement in February. Laura Garwin laments in *Nature* (14 May, 1987) that "several groups have seen drop in resistance at such temperatures (> 200 K) but the behaviour has not been reproducible, and many doubted that true superconductivity was being observed, a view reflected by the fact that the observations were reported mainly in newspaper articles rather than in pre-prints". In India too in the months of June and July scientists were competing with politicians for newspaper space to announce their results. This may be a short cut to claims and publicity but the trend is detrimental to scientific progress. It is difficult to ascertain what is the real claim of the scientist and which is the interpretation of the reporter. The doubts and speculations about the superconductivity at $T_c > 200$ K was set to rest with the publication of the article by

J. T. Chen *et al.* In the *Phys. Review Letters* (in May 1987). They reported both resistance drops and the reverse a.c. Josephson effect in mixed phase Y-Ba-Cu-O samples at temperatures near 240 K. Like the Indian group, they observed the induced d.c. voltage at 240° K coincident with the start of the resistance drop. For them too, the next step is to isolate and identify the 240 K phase. To establish superconductivity Tanaka (University of Tokyo) has given four criteria: elucidation of the structure, observation of the Meissner effect, observation of zero resistance and experimental reproducibility. We have yet to receive such reports, though indications have been obtained.

In Bombay, the scientists at Bhabha Atomic Research Centre and at Tata Institute of Fundamental Research are working on superconductivity. There is no declared collaboration nor do they claim any firsts in the high T_c superconductivity. They are quietly watching the developments, repeating the high claimed experiments and confirming the results. However, they are following keenly each development in the field, critically analysing and understanding. Scientists, at Saha Institute of Nuclear Physics, Calcutta, a few other research institutes and in the departments of the Universities, are working quietly on the new developments. Most of the laboratories in India are equipped with high temperature ovens, high pressure sintering devices and other tools. Measuring instruments, if not available in the laboratory, are available in the regional sophisticated instrumentation centre. Hence what is required is interest, motivation and perseverance to achieve results.

Fortunately for India, the government appears to be in the know of the latest developments in the field and understands the importance of the discovery. The prime minister has set up a cabinet level apex body under his chairmanship to promote research

in the area. All the big wigs are on it: they include the ministers concerned, secretaries of science and technology departments, Chairman of University Grants Commission and members of the science advisory council to the prime minister. This body asserts the political commitment to the emerging field of science and technology.

There is also a programme management body appointed by the prime minister with Prof. C. N. R. Rao, Chairman of the Science Advisory Council at the head of it. It has the executive and financial powers to pursue the programme to its well defined goal. Apart from the finance secretary, it includes eminent scientists, technologists and heads of scientific agencies in various parts of the country. Besides these committees Dr. M. G. K. Menon has been charged with the responsibility of coordination which includes avoiding duplication, intergroup information blackout and other functional bottlenecks and finally providing right incentive for a healthy research atmosphere. Only time will tell the effectiveness of these measures.

It should be stressed that we are living in really exciting times when science is on the verge of revealing one of the important truths of nature which will have profound effect not only on our living standards but on our philosophy and thinking. The materials known as good insulators of electricity, under certain circumstances behaving totally devoid of any electrical resistance and the understanding of the phenomena will lead man to evolve on the mental plane. The worry of energy shortage will be expelled, revolutionary new technologies will develop to assist in our day to day living styles, be it in transport, medical diagnosis and treatment, in industry or in electronics. The last decade of the twentieth century will make great strides in developing the new technologies, to present a brand new way of life in the twenty first century. □

SCANNING ELECTRON MICROSCOPIC STUDIES ON NORMAL, PRECANCEROUS AND CANCEROUS HUMAN ORAL SURFACES

RANAJIT SEN* AND BUDDHADLEB MANNA**

THE scanning electron microscopy has proven to be the most useful in the study of the surface morphology of tissues and cells^{2, 9, 10, 24}. The topographic alteration of the human oral mucosae in the process of malignancy has not yet been recorded by SEM. Although its light and transmission electron microscopic studies are available in normal^{2, 11, 14, 20-23, 25, 26} leukoplakic^{4, 7, 10, 12, 13, 18, 19} and cancerous^{1, 17} persons.

The present communication deals with the SEM study of normal oral surfaces and its alterations in leukoplakic and carcinomatous conditions which may illuminate the possibility of diagnosing different grades of malignancy.

Normal, cancerous and precancerous human oral tissues collected from the healthy persons and patients attending Chittaranjan Cancer Hospital, Calcutta were washed thoroughly with three changes of ice-cold 0.1 M phosphate buffer (pH 7.2) immediately after removal, fixed in 1% gluteraldehyde in phosphate buffer at 4°C for one hour, washed subsequently in phosphate buffer and distilled water, kept in 1% aqueous osmium tetroxide for one hour, dehydrated in different grades of ethanol and finally in amyl acetate, dried by critical point method and coated with a layer of gold-palladium¹⁵. These were viewed with the Philips 500 Stereoscan Electron Microscope operated at 25 KV.

Another set of tissues was fixed in 10% buffered formalin and followed usual procedure for eosin-haematoxylin stain for histologic examination to ascertain its carcinogenic condition.

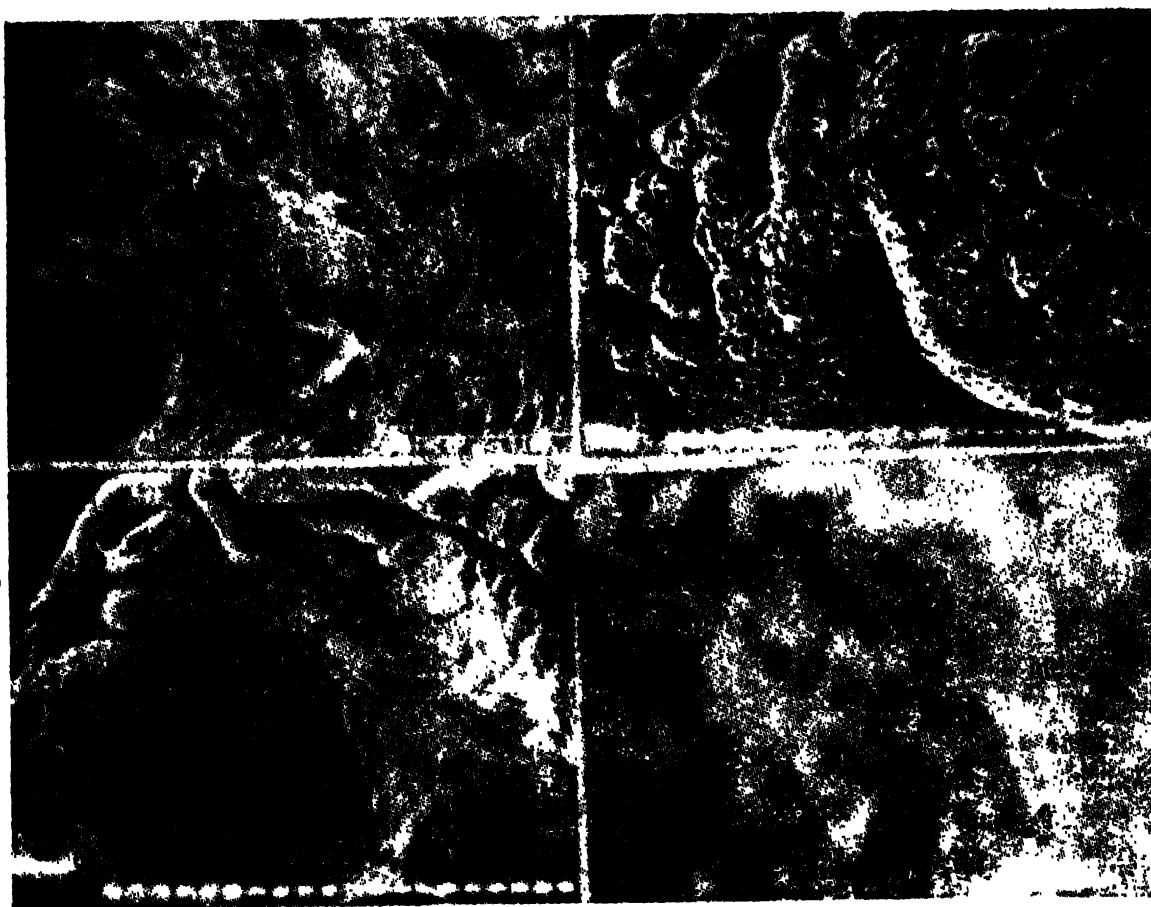
Normal adult buccal mucosae show folding with elevations and depressions of different degrees but without any discontinuity of the surface (Fig. 1).

Adult tongue shows a median furrow at the tip demarking the two halves (Fig. 2). The tip as well as the dorsal and ventral surfaces in the anterior aspect show numerous fungiform papillae of different sizes arranged irregularly. The inter-papillary zones are shallow, sometimes small size papillae peep through the interpapillary space lying at a lower level. The anterior two-thirds of tongue presents the same feature. The number of papillae shows preponderance in the dorsal surface than the ventral. The ventral surface shows more papillae adjacent to the tip than the area far away from it. The papillae in the posterior third of tongue are larger in size and lesser in number.

The palate in the anterior aspect shows transverse ridges and shallow fissures starting from the middle and extending laterally in both sides (Fig. 3). The midline is shallow. The bars in the anterior aspect of palate are shorter, less widened and numerous than the posterior aspect. Some round masses are seen over bars lying more nearer to the midline of the palate. The posterior part of palate shows irregular surface with occasional round elevations and sharp depressions. Some elevations are exceptionally larger arranged haphazardly. These elevations have sharp bulging top and blunt edges. Leukoplakic samples show well defined speckles of different sizes projected on the

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Figs. 1-4: (1) Scanning of normal oral mucosae showing folding of the surface $\times 240$; (2) Tip of normal tongue, showing anterior dorsal surface $\times 800$; (3) Anterior part of palate showing transverse ridges $\times 100$; (4) Leukoplakic oral surface showing spicules $\times 1000$.

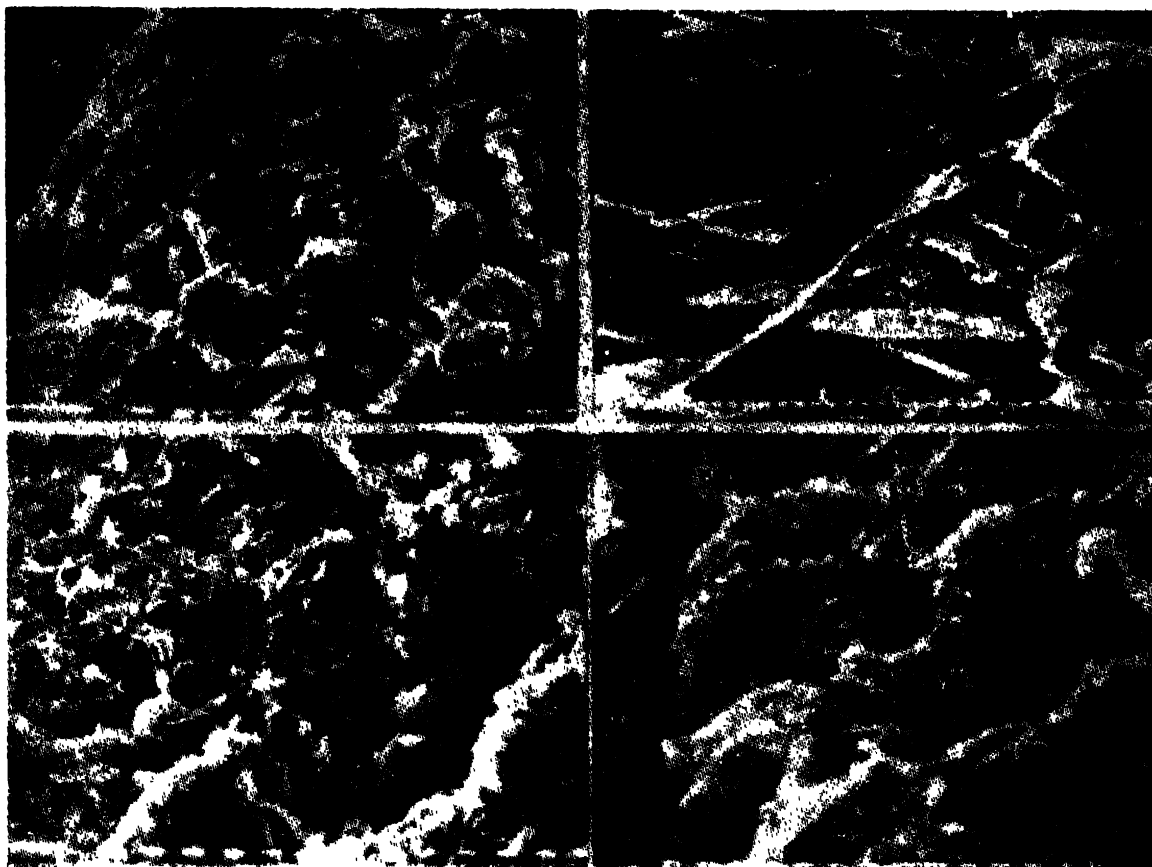
uneven oral epidermis (Fig. 4). In some places these are present in groups and in others they are scattered. Some are smaller and others are blunt. Their size varies from 15 \AA to 2100 \AA with a mean of 1300 \AA .

In the early stage, oral mucosae show unevenness with cracks on the surfaces (Fig. 5). Cheek surface shows irregular growth with occasional bulging. The shallow base near bulgings show fissuring. The bulging masses show again uneven growth pattern on their surfaces. Some cracks are also evidenced on the bulging masses. In progressive cancerous lesions the surface is studded with beads of different sizes. Some beads are exceptionally bigger with tissues in between. The furrow between the beads become greater as the lesion progresses gradually. The surfaces become

progressively uneven with widening of gaps when it leads to the extreme pathological alterations.

In ulcerated condition the surface is eroded exposing uneven wooly surfaced muscle layer, blood cells and capillaries (Fig. 6). The muscles loose compactness and show surface erosion of varying degrees. They show longitudinal cracks along their planes.

In tongue, surface shows different sized nodules with different growth patterns (Fig. 7). The nodules again show beads of different sizes and cracks on their surfaces. Deep seated lesions show foliaceous overgrowth. In ulcerated condition muscles become unveiled with wooly surface and widening of furrow. Similar changes are also observed in palate (Fig. 8).



Figs. 5-8 : (5) Carcinoma in the oral surface showing irregular growth pattern $\times 1000$; (6) Ulcerated carcinoma in cheek showing bare muscles and cracks $\times 1600$; (7) Tongue surface showing irregular growth $\times 1000$; (8) Cancerous palate showing foliaceous growth $\times 3200$.

The present observation reveals the distinctive cell surface pattern, grade and stage which are very much significant on bio-medical ground. Normal tissues show an orderly cellular organization ; leukoplakic tissues present elevated finger-like projections or spicules on the surfaces, while early stage of cancer shows fissuring which ultimately deepen with progression of the lesion. In ulcerated variety, surface shows no cellular membrane, only bare cells with intercellular spaces are evident. So the degenerative changes of both precancerous and cancerous human oral lesions are diverse in accordance with the severity of the disease. The usual changes are the exfoliation of the cheek squamous epithelium leading to the exposure of the muscles, blood capillaries and deep lesion. The formation of dense spicules on the precancerous and early cancerous oral surface is a significant fact which needs further investigations.

Lingual carcinoma, both the early and the established ones, displays a variety of structural alterations of the papillae which evidently show surface fissures and deepening the damages. Cheek, palate and tongue surfaces undergo systemic pathologic changes, some of which are clearly diagnostic for the classification of the cancer with respect to their aetiology. These findings are interesting in view of the conservative oral medicine and surgery. The present study provokes the need of further observations on the ultrastructural alterations associated with different types of precancer and cancer. Recently, however, Bánóczy *et al*¹ has characterised at the ultrastructural level the leukoplakia erosive, the leukoplakia simplex and the leukoplakia verrucosa. Such diagnostic exfoliative cytological investigations require a balance between light, scanning and transmission electron microscopy. □

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THREE BIOLOGICAL CYCLES

VLADIMIR MAKAROV*

The recent achievements in life science, especially in biological processes occurring in the human body, have caused a wave of public interest in biological cycle studies focused on periodical fluctuations in man's organic functions. However, the new scientific developments have also given rise to all kinds of incredible hypotheses and ungrounded speculations.

IN a nutshell, the idea of the three cycles theory is as follows. The moment of man's birth (or conception) is a starting point of his three stable cycles with the periods of 23, 28 and 33 days, which is claimed to determine the person's physical, emotional, and intellectual activity till death. The advocates of the theory also assume that the graphs of the three cycles are sinusoids. On their way from the positive to the negative phase and vice versa, the sinusoids cross the horizontal axis at the so-called zero points. On the days marked by those points the body switches to a different mode of action which is the period of lower work efficiency, lower emotional stability and

intellectual potentials. Such "critical" days are fraught with the risk of contracting infections, feeling bad, having an accident, etc. If two or even three sinusoids cross at one zero point, such a day is considered especially dangerous.

In recent years actually all the papers in biological cycle studies dwelt on the hypothesis of three cycles (which is sometimes referred to as theory in spite of the fact that it has no solid scientific background). Some papers report successful attempts to apply the theory to practice, usually with positive and even promising results. Some authors quote convincing examples of the pre-calculated "critical days" coinciding with car

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accidents. Outbreaks of sickness and premature deaths, linking success with the positive phases of "The Three Cycles" (also based on real incidents).

Yet, science is advanced enough to prove that the three cycles are non-existent.

To begin with, the three cycles are believed to be absolutely stable and independent of any factors, either external or internal, aging included. According to the authors of the hypothesis, those biological cycles work like a clock from the moment of birth till death. According to the actual data obtained by specialists in biological cycles, any cycle known to science is highly individual, sensitive to all the changes occurring in the environment and closely linked with all over functions of the body. The level of those links and reactions change with age. That is why it is impossible to draw the periodical biological cycles as an ideal sinusoid.

The hypothesis was checked by many scientists in different countries—the USA, West Germany, Japan, U. K., France, Bulgaria and USSR. Researchers analysed thousands of car accidents and injuries, air crashes and premature deaths, as well as the course of many diseases and the setting of many sports records, successful exams or thesis hearings. All those cases had nothing to do with the three cycles and never coincided with "the critical days."

Yet, the hypothesis of the three cycles is still quite popular. The recommendations worked out on its basis and used, say, in public transport management, yield some definitely positive results. Drivers in Japan, and later in Bulgaria, USSR and other countries, were warned to be especially careful on "critical days". That recommendation reduced the number of traffic accidents. Soon the management of some industrial enterprises began to plan daily quotas with regard to the above mentioned data, warning the workers about the critical days and phases

of the three cycles. That also brought about some positive results: the number of industrial accidents dropped to 90 per cent in some cases, and work efficiency increased. What are the reasons for all that?

Actually, there are three of them, psychological rather than physiological.

The first reason is one's psychological awareness. A worker informed about the cycles tends to concentrate more on what he is doing, thus reducing the probability of accidents or injuries regardless of critical days. Moreover, such a warning makes his work less monotonous and induces the worker to take a greater interest in it. Besides, the very fact of the warning, as well as control over the workers' physical condition and closer attention to them on the part of the management also improve their mood and enhance their efficiency. Yet, we cannot put those positive results down to the trendy hypothesis alone.

Besides, accidental coincidences are also quite possible, when the critical day falls on, say, Monday known to be a hard day anyway. It is hard because one has to readjust oneself to work routine after the week-end. Incidentally, the same phenomenon is observed at the end of the week.

All that proves that the hypothesis of the three cycles is not scientific. That does not mean, however, that we deny the existence of monthly or, say, daily cycles: they exist all right, and modern science has accumulated some impressive statistics on fluctuations in man's vital functions.

Biological cycles are not isolated from one another. Daily and monthly cycles are parts of an integrate system acting like a multi-stage damping (i.e. levelling excessive fluctuations) factor which helps the body to overcome the consequences of great physical or nervous strain. Under extreme strain or stress the amplitude of biological cycles increases sharply, and the damper tries to

bring down the fluctuation by resisting the "drive" in every possible way. This accounts for the wave-like character of fatigue accumulation in those who work under strain or stress, for instance, in cosmonauts on board orbiting stations.

Soviet medical observations show that monthly cycles in man's physiological functions are highly individual, with different periods (within the limits of 20 to 30 to 50 days), which refutes the hypothesis on the congenital cycle with a highly stable period of 23, 28 or 33 days. The physical condition of a healthy person changes dependent on the phase of his monthly cycle. The rise or fall in his monthly cycle turns the person in question into a typical "owl" (i.e. more active at night) or "lark" (more active in the morning) within the limits of a particular biocyclic type.

Various tests carried out by Soviet medical researchers showed that the range of fluctuations in man's physiological activity is wide enough. Thus the tapping-test (when a patient is observed while operating an apparatus similar to a sender key) proved that the daily rate of the patients' activity, that is, the number of taps per minute, varies between 400-450 to 300-320 taps in different days, the time different between the minimum and the maximum number

of taps amounting to about a month.

Another test, the measuring of the muscular strength in the hand, showed that on the rise of the monthly cycle wave it reached 70 kg and on the fall only 40 to 45 kg, which is quite a gap!

The practical value of the data obtained is great indeed. Those data make it possible to control man's daily routine, as well as distribute work quotas for a month or day with regard to every individual's biological cycle. In the Soviet Union, they were used to plan cosmonauts' work and rest. On the days coinciding with the rise in each cosmonaut's monthly cycle, they were allowed to work longer hours, and on the days when their activity wave was on the fall they would be advised to sleep and rest longer than usual.

It turns out that the falls do not necessarily occur every 23, 28 or 33 days. They can take place before or after time within the limits of 18 to 52 days, and the actual "low activity period" may last longer than one day. It is not recommended to do any responsible or serious work during that period. It means that the real (not imaginary) daily and monthly cycles should be taken into consideration to plan routine work for people of different occupations, as well as in preventive and curative medicine. □

Notes and news

A Cure for Cancer ?

"Chronic diseases of humans and animals", says one of the authors of the discovery, Professor Andrei Malenkov, "occur under the influence of unfavourable external conditions and depend, to a certain extent,

on the resistance of the organism to such unfavourable influences. That resistance is of genetic character. There are families where deficiency in the resistance of a specific organ or tissue is passed on from one generation to another. This is what we call predisposition to disease.

Until recently it was believed that if such predisposition was hereditary, it had to develop in the organism from the

moment of the ovum's fertilization. This means that nothing can be changed, since the future of the new organism is already fixed in the genetic code of its cells, which decides what diseases the individual will suffer from and how long he is going to live.

However, the genetic programme can be changed.

It is known that the mechanical cohesive force between tumor cells is ten times weaker than in healthy tissues. The authors of the discovery have proved that there is direct link between the organism's resistance to the development of tumors and the cohesive force between cells in its tissues. In other words, the cohesive force between cells can be taken as a measure of resistance'.

While looking for nontoxic preparations capable of helping the organism overwhelm a disease, Professor Malenkov and his colleagues Olga Bocharova and Yelena Modyanova studied substances capable of strengthening cohesion between cells. Those substances were separated from organic tissues. After that the researchers tested various agents known for their anti-tumour and wound-healing properties. As a result they obtained a series of preparations with required characteristics which were named contactines.

Then came the numerous experiments on mice. The experimenters studied the effect of contactines on animals belonging to different family lines differing in the degree of predisposition to tumors: some are totally immune to them, others have a certain risk factor, while still others are genetically destined to develop tumors.

The important thing was to follow the reaction of the animals doomed to have tumors to contactines. When those substances were injected to mature mice, they increased for some time the cohesive force between cells in their tissues, but later that force returned to the original level. But how does a very young organism react to contactines? That

question did not arise by itself. The point is that from the viewpoint of mechanical cohesion between cells all mice are born absolutely equal. In the very first weeks, however, curious things happen to them. In the offspring of the families not disposed to tumors the cohesive force approximately trebles, in the mice from the line decidedly predisposed to the disease it remains the same, while in the other offspring it rises commensurate to their position between the two opposite lines.

The experimenters have established what can be described as the normal cohesion between cells in various tissues. For the liver, for example, it stands at 0.3 mg per cell, while for the lungs the figure is 0.1 mg. When actual cohesion is below the threshold figures, there is a direct risk of the disease.

The researchers have also determined the precise period when changes occur in the original intercellular cohesion and tried to inject contactine to young mice predisposed to tumors exactly during that period in doses needed to raise intercellular cohesion to the threshold mark. In other words, they tried to help the organism during its formation to correct the "slips" of nature which had deprived some of the animals of defences against the lethal disease. Their efforts have proved successful. Upon receiving a dose of contactine, the poor devils born in the families with a hundred per cent tumor probability happily lived until the end of their nominal term without any signs of tumors.

So, what is the working mechanism of the preparations developed by Soviet researchers? It has turned out that they do not offset the deficit of a particular substance needed by the organism at the given stage but perform the functions of the missing gene, the one supposed to defend the organism against the formation of tumors.

The discovery has become a crucial step in the development of a fundamentally new

cancer prevention strategy. The inventors say, however, that their work has just started. They are still to find the optimal contactines which must be non-toxic and not organo-specific, which means that they must work for all organs rather than for any specific one. They are also to develop a technology for obtaining these substances in required quantities and to carry out additional lab and clinical tests. It is hard as yet to name the date when contactines will come into practical use. The important thing, however, is that now we have a new promising area in the effort to find a radical solution to the problem of cancer. □

Ella Nikolskaya

Power from biomass

The general device enabling the use of biomass is to ferment it with the help of micro-organisms. As a result, biogas is produced, consisting mostly of methane. Burned at a power station, it yields only carbon dioxide and water, both environmentally harmless.

Of the numerous types of biomass, scientists are seeking to use primarily various organic wastes and sewerage. For example, as early as 1957 and 1969, the USSR launched two biopower plants burning wastes of the acetone-butyl industry. They put out approximately 5 million cubic metres of methane a year and 8 million roubles' worth of vitamin V-12 for agriculture.

There are industrial installations for producing biogas from organic wastes and sewerage in Moscow, Leningrad, Kharkov and Odessa. Soon similar facilities will be put into service in 12 more cities—Minsk (Byelorussia), Riga (Latvia), Kishinev (Moldavia), Baku (Azerbaijan) and others. It is planned to save annually as much as 270,000 tons of equivalent fuel by 1990 by means of reprocessing waste water.

The new installations are based on the method developed by the A. Bakh Institute of Biochemistry, the Soviet Academy of Sciences. Induced by specially grown cultures of bacteria, fermentation occurs in methane-tanks heated to 30-32 degrees Centigrade (the mesophyllous process) or to 52-55 degrees Centigrade (The thermophyllous process). The former yields one volume of biogas per one volume of initial liquid a day, and the latter 2 vol. The choice of one or the other is determined by the composition of raw materials. The resultant biogas is 50 to 80 per cent methane, the rest being carbon dioxide, and its calorific value is from 5,000 to 6,000 kcal per one cubic metre. As much as 85 per cent of organic matter can be converted into biogas and the byproduct is an enriched nitro-phosphoric fertiliser purged of weed seeds, pathogenic microorganisms and other harmful admixtures. So, formerly a costly and power-consuming process, waste water purification is becoming a power source in its own right. According to some estimates, the application of these methods on the national scale will make it possible to produce as much as 2 billion cubic metres of methane a year and a considerable amount of fertiliser, something equivalent to 2 billion tons of conventional fuel a year.

Recently, the State Designing Institute of Consumer Water Supplies has developed a series of urban methane-tank reactors with the capacity of 1,100 to 9,000 cubic metres. Their average cost is 80 to 30 roubles per 1 cubic metre of volume. Used at the Liubertsy and the Kuryanovo water purification plants near Moscow, they help obtain 110 million cubic metres of biogas a year.

Hydrolysis and paper-and-pulp wastes, as well as solid urban wastes have quite a future in the context of biological reprocessing. There are two experimental plants for obtaining biogas from urban garbage in Kharkov, the Ukraine, and a powerful

installation for utilising solid biomass with the capacity of 360 tons a day is on the way. Overall, it is planned to save by this method as much as 500,000 tons of equivalent fuel in 1990.

By the year 2000, the entire mass of organic wastes is expected to be consumed for the production of biogas. It is likely that specific plants will be grown for the power industry and new artificial photobiological and photochemical processes will be introduced. □

Soviet Features

Tracing the origins of honey

To encourage bee-keeping in this country, the USDA pays more for US honey than it does for foreign honey. Producers who take unfair advantage of this subsidy, by buying honey on the international market and reselling it as US honey, are now being thwarted by a pollen expert from Texas A & M University in college Station. By analysing microscopically samples sent by the USDA, anthropologist Vaughn Bryant can determine—sometimes within 50-100 miles—where that honey was produced. Bryant, whose research focuses on the determination of past environments and diets through pollen analysis, first identifies which plants a particular honey sample was made from and then pinpoints the areas where those plants grow. □

Bioscience

Medicinal leeches return

Long since discredited by the medical profession as blood-letting tools, leeches are again being used by doctors at Stanford University Medical Center in California. According to Vincent R. Hentz, head of the Centre's Division of Hand and Upper Extremity Surgery, leeches speed the healing of reattached human fingers and thumbs. Using microscopes, surgeons who reattach amputated digits can also reattach the

arteries that provide blood flow to the area. But the veins that take blood back to the body are too small to reattach surgically and do not grow into the fingertip until several days after surgery. Traditional methods to prevent blood congestion in the reattached digit involve cutting the fingertip and administering systemic anticoagulants. These methods result in so much blood loss that transfusions are often necessary. Leeches provide a better alternative, says Hentz, because they suck blood from the fingertip more slowly and inject small amounts of a natural anticoagulant, hirudin. Unlike systemic anticoagulants, hirudin acts only where it is needed and therefore causes enough, but not too much, blood loss. □

Bioscience

Acid rain in China

Acid rain falling in China poses, as elsewhere, a potential hazard to aquatic and terrestrial ecosystems. Galloway *et al.* compared precipitation from rural and urban-suburban regions of China and the United States. The rain in China has a higher content of sulphate ion, the source of which is coal burned for cooking, heating and generating electricity. Despite enriched levels of sulphates, the pH of China's precipitation is unusually high: in the atmosphere, calcium and ammonium ions (from soil, building materials, and agricultural fertilisers) form compounds that apparently neutralise the strong acid. The situation in China is reminiscent of conditions 70 years ago in Tennessee: high concentrations of sulphate ions prevailed and were attributed to fossil-fuel burning and low-to-the-ground smokestacks that kept pollution close to where it was generated. China's sulphates are estimated to be one or two orders of magnitude higher than sulphates in "remote" regions where human pollutants minimally, if at all, affect the composition of precipitation. □

Science

BOOK REVIEWS

The Wealth of India — By Anon. pp. LIX+513+54, 101 Tables, XI plates, 85 text figures, 1935. Published by Publications & Information Directorate, CSIR and printed at the Photocomposition-cum-Printing Unit, Hillside Road, New Delhi-110012. Price not mentioned.

In 1948, the Council of Scientific & Industrial Research (CSIR) embarked upon an ambitious project of preparing 'The Wealth of India' (WI). That project, a dictionary of Indian raw materials and industrial products, comprising 11 volumes and two supplements, was brought to a successful conclusion in 1976. WI is often the sole treatise where information on the cultivation and growing conditions of countless plants may be available. In fact, it is an indispensable source of information for anybody dealing with subtropical and tropical plants of economic importance.

Y. R. Chadha, the Editor-in-Chief, writes in the introduction, "Since the publication of the earlier volumes of the first edition of the *Wealth of India*, there has been a phenomenal progress in scientific research and surveys on India's natural resources, resulting in a vast accumulation of data. This fact, combined with the persistent demand for updated information from the users of this encyclopaedic work, made it imperative to bring out a revised and enlarged edition of *Raw Materials Series*". The revised edition, which seeks to update the information, would make WI more useful to laymen, students and research workers alike. As predicted by Jawaharlal Nehru, it "will be of great value to the builders of new India". His prediction has come true at last.

In presenting this review, I had to consult the previous edition and I happened to be im-

pressed with a series of remarkable changes. Whereas Volume I of the first edition embraced two alphabets (A-B), the staggering quantum of new data emanating from Indian raw materials during the last three decades have resulted in the creation of two parts for the revised version and one part is our concern for the moment. An examination of Vol. IA has revealed that the text matter covers 513 pages in contrast to 142 pages (under A) of the old edition. At present, there are 204 main entries under the alphabet A as against 153 in the first edition. Side by side, there is a four-fold increase in the number of journals and a five-fold increase in the number of books cited for the revised volume. There has been a fantastic increase in the bibliographic references for three major articles: 110 to 1060 for *Acacia*; 125 to 1925 for *Arachis*; 35 to 450 for *Azadirachta*. As the base reference for each entry, the first edition of WI has been stated.

The current volume includes six items on minerals and 198 genera of plants. The minerals have been arranged according to their common English names, while the plants have been set in the alphabetical order of their generic and specific names. There is an elaborate list of illustrations (plates and text figures); this is followed by a list of books and of periodicals referred to. The text matter starts with *Abelia* (ornamental angiosperm) and ends with *Azolla* (aquatic pteridophyte). The index has been divided into four categories: botanical names; zoological names; active principles and other important chemical compounds; names in Indian languages, regional, trade and common English names. The book has a simple get-up, the printing is excellent and proof-corrections have been very good.

The generous accolade, which the first edition of WI received from leading scientists and scientific journals in this country and overseas, would be showered on the enlarged

second edition. The editorial staff deserve to be sincerely congratulated for their dedicated efforts and unstinted zeal for bringing out this volume. Although the Raw Materials Series took 28 years to compile and the subsequent revision would be a monumental

task to fulfil, let us hope that the remaining volumes of revised WI would see the light of the day before India enters the twenty-first century. That would be hailed as a spectacular achievement of CSIR. □

S. C. Datta

SCIENCE CORNER

Articles published in this section are for students and general readers for understanding science in the perspective of its fundamentals. We invite science teachers and scientists for contributing articles to this section. Also we shall appreciate comments from our readers on the articles published in this section.—Ed.

NEED OF NEW APPROACH TO PALAEOBOTANY

R. K. KAR*

PALAEOBOTANY is the study of ancient plant remains. These may be in the form of microscopic remains like spores and pollen grains or large petrified woods as long as 100 ft or more. The branch of Palaeobotany which deals with spores, pollen grains and other organic microscopic remains is called Palynology. Besides other utilisations, this branch has some applied aspects and helps in fossil fuel exploration.

Studies in Palaeobotany in India is being continued for more than two centuries and universities like Calcutta, Burdwan, Allahabad, Lucknow, Nagpur, Pune, Kolhapur, Bombay, Bangalore and Osmania have this branch of science in their curricula. The Geological Survey of India carried out the work on Palaeobotany with utmost zeal

and devotion and published monumental works written by Feistmantel, Oldham and Morris in the nineteenth century. The Birbal Sahni Institute of Palaeobotany, Lucknow is solely devoted to the cause of Palaeobotany and pursuing research on its various disciplines.

Palaeobotany, as it stands today in India, has, however, failed to have an impact on the related disciplines. The reason probably is the workers mostly devoted their time to mere morphographic description of the specimens and have hardly endeavoured to read the meaning into it to understand and interpret them. This has subsequently resulted in the proliferation of new species resulting into a great confusion.

The species of *Glossopteris* was first des-

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cribed from India in 1828 by Brongniart and in the last 150 years many more species are described from various Gondwana sediments. This genus existed for more than 40 million years during which it evolved and flourished in glacial and semiglacial condition and disappeared in dry and arid climate. Has there been any effort to decipher its ancestral form, its lineage and further evolutionary proliferations and manifestation into other groups? The research on this line will open a new vista of knowledge to the evolutionary botanists.

During the Mesozoic Era, the Cycadales and its allies dominated and their remains are found in abundance in the form of petrifications in the Rajmahal Hills, Bihar. These fossils are found in association with volcanic flows whose radiometric dates are available. The urgent need is to correlate these findings, but the plant fossils have never been placed in a sequential order along with the volcanic flows to bring out the evolutionary tendencies of these floras. We still consider this flora to be of Jurassic while radiometric dates differ. Coordinated research is needed to evaluate our own work on fossil floras.

As plants are indicators of environment a meaningful interpretation is needed to understand the whole assemblage rather than the individual fossils. As for example, a delta complex has both continental, marine as well as marginal marine floral elements. Finding of fresh lacustrine floral representative does not mean that it deals with an entire continental sequence.

With the advent of Tertiary Era, angiosperms proliferated and their fossils became abundant in the Indian sedimentary basins. Some of the earlier forms have been entombed in rocks in eastern and western regions of India but a serious endeavour has seldom been made to trace the evolution and vegetational history of the angiosperms in India. There is a need to do more research and inte-

grate Palaeobotany and Palynology in this area.

The palaeobotanists in India have rarely helped the geologists or evolutionary botanists. As a result, a serious communication gap between the palaeobotanists and geologists came into existence.

Palaeopalynology helps in coal and oil exploration by determining the age of sediments, correlating them, deciphering favourable condition of deposition and by demarcating age boundaries in sedimentary sequences. Palynologists have also indulged more in morphographic description. They have not worked seriously on different sedimentary models to project their findings to postulate palaeoecological condition of deposition of basins which hold economic deposits. They have hardly listed stratigraphically important palynological taxa as marker fossils for different formations for a clear comprehension of other workers. They have also failed to generate interest among fellow geologists to solve age controversies or boundary problems.

To overcome these drawbacks, the Palaeobotanists should collaborate with other scientists of sister disciplines to unravel the history of the sedimentary basins. They should study the sediments from different environments to know what is happening in the present day.

They should also do research in new directions. The origin of life is a problem of topical interest to all biologists. In India, we have pre-Cambrian rocks whose age is approximately 3-4 billion years old. These rocks are generally highly metamorphosed, so new techniques to disintegrate them should be developed. Caution is commendable and over-enthusiasm should be discouraged in reporting biota from these sediments as often contaminated recent forms have been illustrated as fossils from these horizons. Stromatolites should also be studied earnestly in this light as the oldest stromatolites from India is

known from 3 billion years old rock. Microbiota associated with these sedimentary structures should also be studied with utmost care to identify nature of life in those by gone days.

It is known that India drifted northwards like a 'Noa's Ark' covering approximately a distance of 5,000 km within a time span of 70 million years. This wandering exterminated some species but also gave opportunity to some to evolve and flourish. During the drifting, India might have also been populated by other plants which have become extinct and possibly migrated to other countries making new homes.

The drama that was enacted during this migration has been recorded in the sediments in the form of fossils. The scientists of deep sea drilling expeditions postulated that the clue of relative and changing position of India and Australia might lie in the ocean floor between Bengal Fan, central Indian basin and Ninety east ridge. No collective endeavour has been attempted to study these rocks. This is a vital issue with far-reaching consequences where Indian Palaeobotanist/Palynologist could have taken a lead. But most of us have failed to understand its importance. □

Letters to the editor

Synthesis of humic substances in presence of algae

Humic acids constitute an important group of organic compounds in soils and natural waters. Aquatic humic substances originate from soil humic material and terrestrial and aquatic plants.

Preparation of synthetic humic acids have been adopted to resolve the complex problem in elucidating the structures of humic substances^{1,2} and their mode of formation in nature. The present study was undertaken to explore the possibility of using algae as an aid in the humification of mixtures of phenolic compounds and simple amino acids both in presence and absence of clay. Properties of these synthetic polymers were studied³ by Electrometric titrations, Viscometric and Spectrophotometric methods to characterise these products. P-benzoquinone and glycine were the phenolic compounds and amino

acid used in the present investigation. The soil clay used was illite dominated clay isolated from Kalimpong soil of North Bengal.

The soil clay was treated with H_2O_2 to remove the organic matter before use. The algae (*Spirogyra* sp. of group chlorophyceae) used was collected from Sagar Islands near the shore of Sundarban belt in West Bengal. It was freeze dried, ground in a mortar and added.

Equal amounts (15 gms) of p-benzoquinone and glycine was mixed with 2.0 gms of the algae in presence and absence of soil clay in separate reaction vessels and the pH was adjusted to 8.0 with 0.1 (N) $Ca(OH)_2$ solution. The suspensions were shaken gently for a period of 20 days and the pH was maintained at 8.0 throughout this interval. On the twentieth day, when the reaction was complete as revealed from preliminary study, the contents of the flask were centrifuged to remove the unreacted p-benzoquinone, glycine, soil clay and algae. The centrifugate was acidified with 0.1 (N) HCl. The precipitated humic materials were dialysed, air dried and stored.

TABLE 1

Humic acid	CEC value	Carboxyl	Phenolic	Mol.wt.	E_4/E_6
Sample	meq(100g) ⁻¹ pH metric	group meq (100g) ⁻¹	(OH) meq (100g) ⁻¹	\bar{M}_v	
Syn-HA-(I)	430	250	180	11128	2.9
Syn-HA-(II)	450	258	192	12652	2.5

The humic materials thus obtained are designated as follows :

Symbol assigned

- (i) Synthetic humic acid from p-benzoquinone, glycine using marine algae as catalyst. —Syn-HA-(I)
- (ii) Synthetic humic acid from p-benzoquinone, glycine using marine algae as catalyst in presence of soil clay. —Syn-HA-(II)

The electrometric titrations were carried out against 0.1 (N) NaOH solution by using an Elico-pH meter (LI-10). Carboxyl content was estimated by the calcium acetate method of Schnitzer and Gupta³. The phenolic -OH group content was taken as the difference between total acidity and carboxyl content. The E_4/E_6 ratios were determined by dissolving 0.5 mg of model humic polymer in 25 ml of 0.05 N NaHCO₃ and measuring the absorbance at 465 and 665 nm on a Elico spectrophotometer.

The viscosity measurements were carried out with the aid of a Ubbelohde viscometer (flow time at 25°C of 25 ml of water is 146 secs). The viscosity data was fitted to the modified Staudinger's Equation⁴ in order to obtain the "viscosity-average molecular weights of these samples.

The electrometric titrations show two inflection points (fig. not shown) the first due to -COOH groups and second one due to phenolic -OH groups like natural humic acids³. The humic acid synthesised in presence of soil clay (HA-II) have higher CEC (450 meq/100 g) in comparison to the humic acid prepared in absence of soil clay (HA-I) which show a CEC value of 430

meq/100 gm of HA. The -COOH and phenolic -OH group content of the 2 humic polymers are shown in the Table 1. This indicates that the algae is effective in humification in presence of soil sediments.

According to the modified Staudinger's equation

$$\eta_{sp}/c = [\eta] = K\bar{M}_v^\alpha$$

Where $K = 7.33 \times 10^{-4}$ and $\alpha = 0.65$ (a value for most flexible polyelectrolytes are constants, characteristic of the given material) and \bar{M}_v is the corresponding viscosity average molecular weight. Where $[\eta]$ is the intrinsic viscosity. The molecular weights of the synthetic humic acids are shown in Table 1. It is evident that the degree of polymerisation is more in Syn-HA-(II) which is in agreement with the CEC as well as contents of carboxyl and phenolic (OH) groups (vide Table 1).

The E_4/E_6 ratio decreases with increasing molecular weight and condensation and is believed to serve as an index of humification⁵. Thus the lower E_4/E_6 value of Syn-HA-(II) sample indicates more condensation of aromatic part of this molecule in comparison to the Syn-HA-(I). IR spectroscopic result confirms the humus characteristics of these product like natural one.

Thanks of the authors are due to Prof. A Chowdhury for kindly supplying us the weeds (algae)

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Received : 10 June, 1986.

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Effect of different post-emergence herbicides on seed output and seed viability of some weeds

Successful weed control by using herbicides and their effect on crop growth and metabolism have been documented in this arid tract¹⁻³. However, no attention has been paid so far on the effect of herbicides on propagules production (seeds and tubers) of treated plants, which in fact, are means of dissemination and infestation of weeds in newer areas. The severity of any weed in the forthcoming season depends upon the production and survival of viable propagules¹. Hence, the selection of different herbicides for affecting the growth of weeds, their seed output, seed germination, and seedling growth is of utmost importance. The present

investigation, thus, aims at studying the effect of different post-emergence herbicides on the seed output and seed viability of three important kharif weeds in Indian desert: *Borreria articularis* (Linn.) F.N. Will., *Cyperus rotundus* Linn. and *Gisokia pharnacioides* Linn. The former two compete severely with pearl millet and sesame, causing yield losses ranging from 17.5%-65.6% in pearl millet and 19.3%-45.1% in sesame, respectively^{1, 3}.

Three herbicides—Agrodone Concentrate 48 (2,4-D ethyl ester), Agrodone 18% W. P. (2,4-D ethyl ester), Agrodar 96 (2, 4-D dimethyl amine) (@ 1.24 kg/ha, 1.25 l/ha and 1.24 kg/ha, respectively)—were tested for weed control in kharif crops during 1985-86. The seeds of the three weed species (*B. articularis*, *C. rotundus* & *G. pharnacioides*) produced after treatment were collected. To compare the effect of herbicides, seeds were also collected from plants free from any herbicidal effect (control). Seed weight, seed output and viability were investigated. Viability was tested using 0.1% solution of TTC (2, 4, 5 triphenyl tetrazolium chloride)⁵. Seed output was calculated and 100 seed weight was measured using monopan electric balance⁶.

TABLE 1 : Effect of three post-emergence herbicides on seed output, plant and weight (100 seeds) of *Borreria articularis*, *Cyperus rotundus* and *Gisokia pharnacioides*

Weed species	Control		Agrodone concentrate 48		Agrodone 18% W.P.		Agrodar 96	
	Seed out-put/plant	Weight (mg)	Seed out-put/plant	Weight (mg)	Seed out-put/plant	Weight (mg)	Seed out-put/plant	Weight (mg)
<i>Borreria articularis</i>	92.86± 20.07	290.0± 13.85	14.66± 4.50	252.0± 7.21	11.25± 9.60	280.0± 8.0	13.75± 5.95	244.0± 0.0
<i>Cyperus rotundus</i>	66.5± 4.72	46.0± 2.0	57.53± 22.78	42.0± 2.0	61.85± 11.01	43.33± 2.30	63.87± 9.28	37.33± 8.08
<i>Gisokia pharnacioides</i>	67.72± 3.92	24.00± 2.0	34.70± 2.99	17.33± 3.05	47.0± 27.05	14.0± 4.0	60.66± 21.36	18.0± 2.0

Table 1 presents the values on the weight and seed output/plant in control and that after three herbicide treatment. The weight of 100 seeds and seed output/plant of all the three weed species showed diminution after herbicidal treatment. *C. rotundus* exhibited very little effect on seed output by all three herbicides; while *B. articularis* and *G. pharnacioides* showed more, being maximum on *B. articularis*.

in case of Weedazol and Avenge treated plants as compared to Weedone and Diuron⁷. It was also reported that in *B. articularis*, *Dicoma tomentosa*, *Pulicaria crispa* and *Trianthema portulacastrum*, seed output and weight of 100 seeds decreased in different post-emergence herbicide-treated plants, being more in Weedone and Glyphosate³. This study further confirms the findings with regard to the reduction in

TABLE 2: Effect of three post-emergence herbicides on viability (percentage) of seeds of *B. articularis*, *C. rotundus* and *G. pharnacioides*

Weed species	Control viability	Agr. C. 48 viability	Agr. 18% W. P. viability	Agr. 96 viability
<i>Borreria articularis</i>	100 ± 0	85.0 ± 7.07	80 ± 10	70 ± 5.7
<i>Cyperus rotundus</i>	90 ± 10	76.6 ± 5.7	75 ± 5.7	73.3 ± 5.7
<i>Gisekia pharnacioides</i>	100 ± 0	73.3 ± 5.7	70 ± 0	70 ± 0.0

Viability percentage of all three species in control and after herbicidal treatment are presented in Table 2. All species showed a reduction in viability due to herbicidal treatment. Agrodane Concentrate 48 has less effect on the viability (85%) on seeds of *B. articularis*, but in Agrodar 96 it reduced the viability to 70%. The seed viability of *C. rotundus* was reduced to a maximum (73%) by Agrodar 96% (90% viability in control). Both Agrodar 96 and Agrodane 18% W.P. reduced the viability percentage of *G. pharnacioides* to 70% (100% in control).

The results obtained in the present study prove that the post-emergence application of herbicide not only affects the growth of the plants but also has inhibitory effect on the production of propagules. In case of *B. articularis*, all the three herbicides reduced the seed output very much and thus the germinability of seeds. The reduction in viability and seed output of weeds due to herbicidal treatment can be used as a main tool for prediction of weed infestation in the forthcoming season. Reduction in germination of seeds of *Amaranthus viridis* by different post-emergence herbicides was more

viability and germination of *B. articularis* being more in case of Weedone and Weedazol⁸.

Thanks are due to Head of Botany Department for providing facilities and ICAR for financial assistance in the form of a research project.

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Received : 14 January, 1987.

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Size relationship of oocytes their nuclei and nucleolus in two fresh water fishes

Gonads plays a vital role in propagation of fish crop. Recently nuclear intervention in cytoplasmic growth and differentiation has formed the subject of many studies. On significant observation from these studies in the recognition of the major part played by the nucleus in developing oocytes¹⁻⁶. The size of the nucleus and nucleolus in different stages of growth of oocyte is important aspect for such studies. The chemical changes undergone in the nucleolus and nucleus can also be related to the oocyte growth. There is little information available on the volume relationship of different cell structures and the related functional significance during the maturation of oocytes. This paper embodies results on the size relationship of the oocyte, nucleus and nucleolus in two fresh water fishes *Labeo gonius* and *Schizothorax richardsonii*.

The specimens of *L. gonius* and *S. richardsonii* were collected from the Nanaksagar reservoir and the Balkhela river respectively for a period of two years. The pieces from anterior, middle and posterior regions of the ovary were fixed in various fixatives. The paraffin sections were cut at 5-7 micra in thickness and stained in Delafield's haematoxylin, iron haematoxylin, Mayer's haemalum using eosin as counter stain and Mallory's triple stain. The diameter of oocytes, nucleus and nucleolus were determined following the methods given by Clark⁷.

Babber *et al.*¹ reported that in *L. pangusia* oocyte grows to a maximum diameter of 960 m μ . In *L. gonius* and *S. richardsonii* the oocyte grows to a maximum diameter in 990 m μ and 955 m μ respectively. The diameter of nucleus in very young oocyte of *L. gonius* and *S. richardsonii* varied from 30 to 45 m μ and 34 to 68 m μ respectively. The size of oocyte increases along with the increase in the size of nucleus (Table 1). This shows that the size of nucleus increases

TABLE 1 : Size relationship in oocytes, their nuclei and nucleolus in *L. gonius* and *S. richardsonii*

Stage of oocytes	Oocyte (m μ)	Nucleus (m μ)	Nucleolus (m μ)
<i>L. gonius</i>			
Young oocytes	45 - 75	30 - 45	15.5 - 16.2
Mature oocytes	945 - 990	190 - 195	6.0 - 6.3
<i>S. richardsonii</i>			
Young oocytes	45 - 120	34 - 68	14.0 - 15.0
Mature oocytes	900 - 965	170 - 180	7.4 - 7.5

upto the end of vitellogenesis. In the ripe oocytes ready for ovulation no nucleus is visible. The average size of nucleolus has been noted upto a maximum of 16.2 and 15 m μ during resting phase in *L. gonius* and *S. richardsonii* respectively. The size of nucleoli shows decrease after resting phase and found minimum in the mature oocytes in both the fishes (Table 1). The reduction in the size of the nucleoli is due to the division of the single nucleolus present in the very young oocytes. The further decrease in the size of nucleolus was not significant but the number of nucleoli increased considerably. Nuclear extrusion was common upto the end of vitellogenesis in both the fishes.

From these observations it appears that the nucleolus and nucleus are active in early growth of oocytes i.e. previtellogenesis is contributing mainly towards its protein and lipid contents. It is evident by the increase in the number of nucleoli rich in lipoprotein and RNA together with the nuclear extrusion in the early growth of oocyte. Movement of nuclear extrusion towards the periphery of oocytes and their disintegration before the onset of vitellogenesis indicates their indirect role in the formation of yolk during vitellogenesis. The present results are similar to those of the few earlier workers^{1,4-6}. The nuclear emission and the role of the extruded material seems to be associated with vitellogenesis.

The author is grateful to Dr. S. S. Khanna, Director of Higher Education, U. P.

Government, Allahabad for his encouragement. Thanks are due to U. G. C. for financial assistance to College teachers.

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Received : October, 1986.

Revised : 4 May, 1987.

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Life history of *Tricentrus gibbosulus* Walk (Insecta : Membracidae), a serious pest of betelvine (*Piper betle* L.) in West Bengal

Studies on Indian membracids are limited to Distant^{1,2}, Subramaniam^{3,4}, Behura^{5,6,7} Ananthasubramaniam and Ananthakrishnan, and Ananthasubramaniam⁸. No information is available on the membracids of eastern India. The present authors in course of their studies on the ecology of betelvine pests noted the occurrence of the membracid *Tricentrus gibbosulus* Walk on betelvine (*Piper betle* L.) in Tamluk, Midnapore, West Bengal. Investigation on its ecology, behaviour and life history have been made under field condition. The present communication deals with the life-history of this betelvine pest studied during the period March 1984 to November 1985.

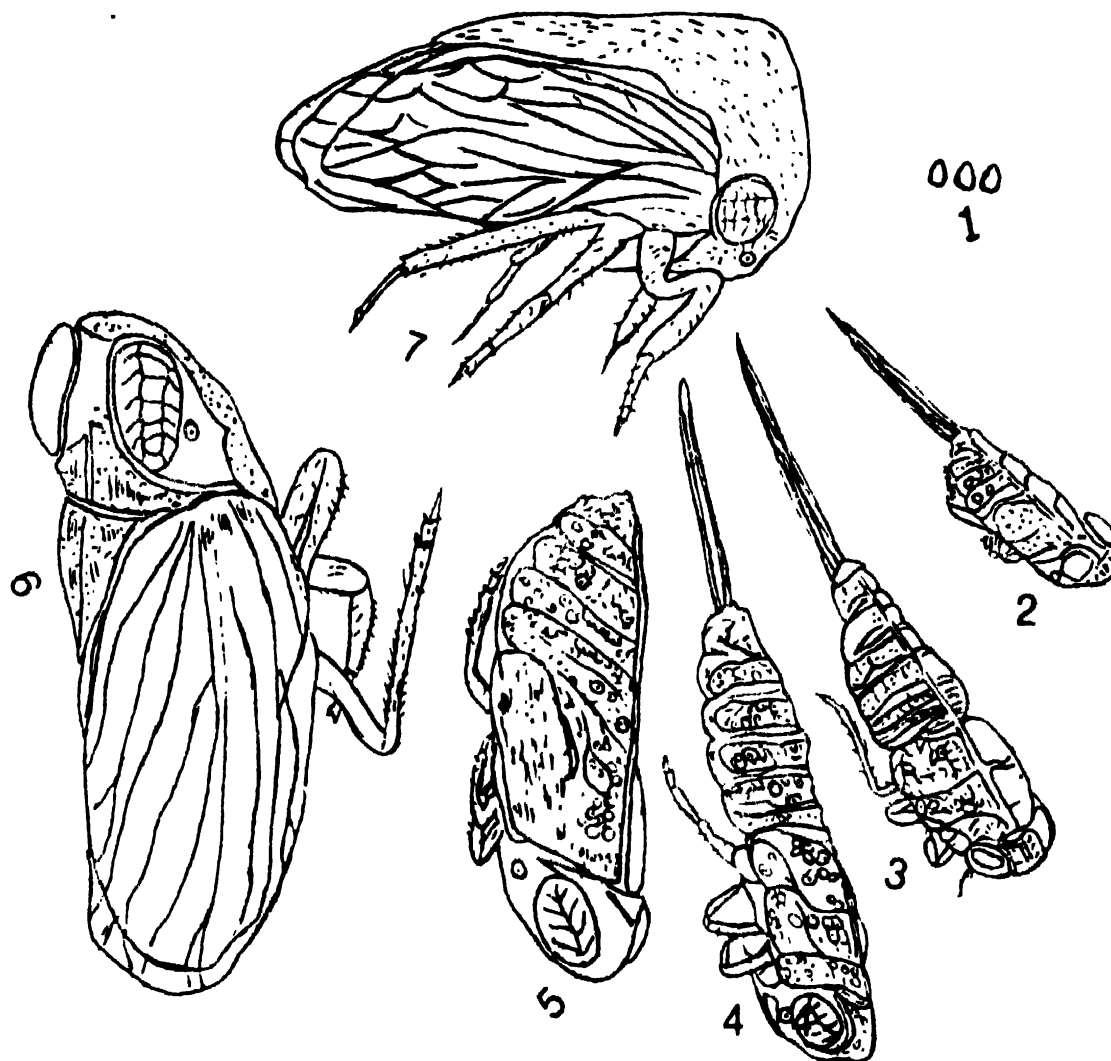
For the study of life-history of *T. gibbosulus*, 20 healthy betelvine plants were selected from a membracid infested 'boroj'. The eggs and other developing stages of *T. gibbosulus* were removed from the leaves

of those selected plants. Following this, the leaves of the plants selected were watched constantly to note the eggs just after laying. Few such groups of eggs were marked and those leaves were covered by a piece of fine nylon net to collect the cast skins. The measurements, duration and characteristic features of eggs and nymphs have been noted. For description, camera-lucida drawings of the developmental stages have been considered.

In the betelvine orchards, frequent copulation in *T. gibbosulus* has been observed during daytime and the duration of mating was 5-8 minutes. The females deposited eggs in groups, usually 2-3, on the ventral surface of the leaf at an interval of 48 ± 12 hr. The eggs were found in rows (Fig. 1) and the number of eggs per group ranged from 4-6. The eggs are shining white, elongated, with a slight curvature on the lateral margins. On an average, they were 0.4 mm in length and 0.2 mm in breadth. The eggs required 10-12 days for hatching. Following this, the nymphs metamorphosed into adult through the undermentioned five instar stages.

First instar : (Fig. 2) : Cream-coloured cylindrical body with 3.1 ± 0.4 mm (body 1.1 ± 0.3 mm and tail 2.0 ± 0.1 mm) in length. The broom-like tail consists of eight sticks of different sizes and is loosely attached with the body. Antennae with six segments, eyes prominent with two ocelli, located above the centro-ocular line. Thorax with three segments, abdomen with six, the last abdominal segment bears a tuft of hair; thorax with three pairs of legs which are punctate pellose, first pair with a claw at the end, second is provided with a club like structure at the end, and the third is saltatory and clawed.

They were very active and preferred to reside on the ventral surface of the 3rd, 4th and 5th top leaves.



Figs. 1-7. Life cycle of *Tricentrus gibbosulus*. (X 10) : (1) Eggs, (2) First instar, (3) Second instar, (4) Third instar, (5) Fourth instar, (6) Fifth instar and (7) Adult female of *T. gibbosulus*.

Second instar : (Fig. 3) : Body dorsoventrally flattened, cream coloured, 4.3 ± 0.3 mm (body 2.1 ± 0.2 mm and tail 2.2 ± 0.1 mm) in length, well developed wing pads, hypognathus mouth parts, last abdominal segment slightly bifurcated, mouth parts piercing and sucking type, labium forms hollow groove and mandible-maxillae resemble two pairs of fine needle like structure. Eyes, legs and other structures are similar to first instar.

Equally active like the first instar.

Third instar : (Fig. 4) : Body dorsoventrally compressed, cream coloured, 4.4 ± 0.25 mm (body 3.0 ± 0.1 mm and tail 1.4 ± 0.1 mm) in length, wing pads cover the entire

thoracic region, last abdominal segment with prominent bifurcation. Other characters are similar to second instar.

Comparatively more active than those of first and second instar.

Fourth instar : (Fig. 5) : Whitish brown in colour, dorsoventrally flattened, body length 3.5 ± 0.5 mm, tail absent, precursor of two pairs of wing, thorax with three segments and much heavier than abdomen, pnotum large, last abdominal segment bifurcated, tube like, with a tuft of hair at both sides, clypus large and stout. The remaining structures are similar to second instar.

Highly active, preferred the ventral sides of third and fourth top leaves as well as the apical shoot.

Fifth instar : (Fig. 6) : Grey in colour, 4.7 ± 0.1 mm in length, head twice as wide as long, texture of the integument is soft, wing membranous with complete venation, snout hypognathous, clypeus large, highly convex, antennae with six segments, legs are punctate pilose, first pair with claw, second with round club at the end, and the third saltatory. No change in other structures has been noted.

Highly active, observed on the stem, twig and top leaves.

Adult female : (Fig. 7) : Body 4.1 ± 0.2 mm in length, general colouration black, integumental texture soft, head twice as wide as long, finely pilose with silvery hairs, eyes reddish brown, ocelli two, wings well developed, first with reticulate venation, ovate in shape, principal vein six in number each with two or more bifurcations, no bifurcation in second wing but other structures are similar to first wing, both wings have hair like structure, femur thick and stout, first pair with a claw at the end, second pair with a round club at the end, third saltatory but clawed, ovipositor darker.

Very active and are found in all leaves except the two top leaves.

Adult male : Body length 3.7 ± 0.1 mm, slightly smaller than the female, abdomen slender, genitalia with sternal black plate. The males resemble the females in all other respects.

Longevity : The average life span of different instars and adult was as follows.

Instar	Longevity (hr)
1st	216 ± 26
2nd	112 ± 32
3rd	96 ± 22
4th	96 ± 24
5th	240 ± 38
Adult	336 ± 48

It is observed that a female, in its entire life span produced, on an average, 15 eggs.

From the study of life-history of *T. gibbosulus*, it is evident that the presence of a tail in first, second and third instar stages is a must. It is surprising that Ananthasubramaniam and Ananthakrishnan⁷ did not mention the same in their description of five species under the same genus. It is still not clear whether tail is specific for *T. gibbosulus* or common to the members of the genus *Tricentrus*. It is also to be mentioned here that the occurrence of *T. gibbosulus* has been noted from Calcutta by Distant¹ but he did not mention the host plant. The present study records betelvine, *P. betle* as the host of *T. gibbosulus* for the first time.

The authors are thankful to Dr. L. K. Ghosh, Zoologist, Zoological Survey of India, Calcutta for identifying the specimen. Thanks are also due to the University Grants Commissions for financial support.

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Revised : 15 June, 1987.

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Biology of the tussock caterpillar *Dasychira mendosa* (Lepidoptera : Lymantridae) and rate of leaf consumption on rose

Rose is widely cultivated in lawns and gardens for the invaluable cutflowers. Several species of insects are known to feed in this important ornamental plant¹. The tussock caterpillar *Dasychira mendosa* Hubner a polyphagous pest², is known to feed voraciously on the leaves of rose. Studies were undertaken to assess the extent of feeding and also the development of this important pest on rose plant.

The studies on biology and leaf consumption of *Dasychira mendosa* on *Rosa* sp were conducted under room temperature (21°-29°C) and relative humidity (31 to 60 per cent). The newly hatched larvae drawn from the running culture in the laboratory were reared singly in petridishes of 7.5 cm diameter for the study, each larvae was replicated 22 times. The bottom of the petridishes was lined with moistened filter paper to prevent food material from drying. Every day the larvae were supplied with fresh leaves once or twice if required. Observations on duration of each instar, pupal and adult periods, size of each stage were made. The total leaf area consumed during each

instar was also computed by measuring the area with planimeter.

Adults emerged only during night hours and mated soon after one to three minutes. Females layed eggs in masses on host leaves, cocoons and other substratum. Unmated females laid unfertile eggs.

The females were larger than males; their mean measurements at the wing expanse were 4.6 and 2.7 cm, respectively. They could live for 4 to 6 days without food and 9 to 11 days on 10 per cent honey solution. Fecundity was 120 to 426 (Mean = 300) eggs per female.

Freshly laid eggs were white, but soon turned to cream. Towards hatching blue tinge appeared on the eggs. Eggs were sperical measuring 0.9 to 1.0 mm, with slightly flattened top and a depression at the centre. They hatched during cool hours. Incubation period lasted for 6.5 to 7.00 days (Table 1).

The newly hatched caterpillars were dull white, turning yellowish orange on the second day. Head was also brown with a notch at the posterior end. Prothoracic shield was also brown with two prominent orange coloured tubercles on either side bearing tuft of dark hairs of different length, projecting forward.

TABLE 1 : Development and rate of feeding of *Dasychira mendosa* on rose under Laboratory Conditions (Number observed : 22)

Stage of development	Duration in days				Leaf area consumed in cm ²			
	Minimum	Maximum	Mean	SD ±	Minimum	Maximum	Mean	SD ±
Duration of egg stage	6.50	7.00	6.45	± 0.90	—	—	—	—
I Instar	3.00	4.50	3.86	± 0.27	0.67	1.80	1.10	± 0.31
II Instar	2.00	3.00	2.22	± 0.49	0.88	4.62	2.42	± 0.98
III Instar	3.00	4.00	3.54	± 0.68	30.16	46.06	37.58	±13.06
IV Instar	3.00	5.00	4.50	± 1.20	42.60	79.00	52.11	±17.86
V Instar	2.00	4.00	3.86	± 1.53	82.00	180.00	148.64	±43.29
Pupa	4.00	6.00	5.00	± 0.36	—	—	—	—
Adult	4.00	6.00	5.00	± 0.36	—	—	—	—
Total	27.5	039.50	34.43	—	156.37	311.48	241.85	—

The two verrucae near the mid-dorsal line of first four abdominal segments were more conspicuous which bore characteristic tufts of hairs in the later instar. The first instar caterpillar measured 4 mm in length. Its duration ranged from 3.0 to 4.5 days with an average of 3.86 ± 0.27 days.

The body of second instar larvae covered by yellow setae. The prothoracic legs were larger than other. The orange coloured anterolateral process were black at the apex and bore tuft of hair of different length. The dorsal verrucae on the first four abdominal segments were dark and coalesced to form a transverse band in each segment. The second instar measured 5.6 mm long, lasted for 2.0 to 3.0 days with an average of 2.22 ± 0.49 days.

The head of third instar larvae was reddish brown with distinct orange coloured prothorax. The anterolateral tubercles of the prothorax with a dense tuft of long dark setae. First two abdominal segments had dorsal brown tuft of hair which were short on the third and fourth segments. The third instar was 8 mm long, lasted for 3.0 to 4.0 days with an average of 3.54 ± 0.68 days.

The fourth instar larval head was brown with conspicuous, abundant hair. The anterolateral processes of prothorax were needle like, hair projected forward beyond the head. Conspicuous lateral tufts of yellowish white setae were present in the first abdominal segment and the next three segments bore dorsal yellowish prominent brush like hair. Tufts of long brown hairs, of variable lengths arose from the dorsal aspect of eighth abdominal segment. The length of fourth instar caterpillar was 17 to 19 mm, lasted for 3.0 to 5.0 days with an average of 4.50 ± 2.0 days.

The fifth instar larva was similar to fourth instar except for the increase in size of body and intensity of lateral orange colour. The dorsal tufts of hairs on the first

four abdominal segments were more or less equal in length. The length of fifth instar caterpillar was 27 to 30 mm, it lasted for 2.0 to 4.0 days with an average of 3.86 ± 1.53 days.

Pupa is oblong, and is formed within a transparent cocoon made of prepupal setae entangled with the silken threads. Pupal stage lasted for 4 to 6 days. The size of female pupae was larger than male ones. Their respective lengths were 1.5 to 1.8 cm and 0.8 to 1.25 cm. On the pupae two days prior to adult emergence, there appeared conspicuous eye spots, wing region turned from brown to black and dorsum from light brown to deep brown.

Feeding habits and leaf area consumption:

First instar larvae on hatching devoured contents of egg shell and moved on to the upper leaf surface and fed on it in congregation. Each first instar larva nibbled an area of 0.67 to 1.80 sq.cm.

During the second instar, caterpillars were able to bite holes in the leaves. The average leaf area consumed was 2.41 sq.cm. Third, fourth and fifth instar larvae fed voraciously. The leaf areas consumed under each stadia respectively were 30.16 to 40.16, 42.6 to 79.00 and 82.00 to 180.00 sq.cm. with corresponding mean values at 37.58, 52.11 and 148.64 sq.cm.

The authors are grateful to Dr. J. D. Holloway, Commonwealth Institute of Entomology, London, for determining the insect.

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Effects of light and water on ethylene production

Ethylene, a natural plant-growth regulator, can bring about changes in morphological and physiological parameters of various plant species. The effects of ethylene on plant growth are commercially important and observed especially during critical periods like germination, abscission, senescence, fruit ripening, etc. in the life cycle of higher plants¹. The effects of external environmental stresses on ethylene production have also been reported². In the present study, effects of light and water on ethylene production have been investigated in leaves of sunflower plants.

Ethylene emanation from excised 3rd leaves (counted basipetally) of 30-40 day-old plants was estimated following the method of Wright³ with some modifications. The upper

leaf of the last extended internode was considered as the first leaf. Two excised leaves were placed in each 50 cm³ test tube with or without 0.5 cm³ water. Each tube was sealed with a subaseal cap and the tubes were incubated in the continuous light at 25°C. To achieve dark condition, each tube was wrapped in two layers of aluminum foil prior to incubation. A 1 cm³ air sample from each tube was taken away every 2 hr for estimation of the rate of ethylene emanation. Each tube was opened for aeration every 2-4 hr to avoid oxygen deficiency or any inhibitory effect due to the accumulation of toxic products. Ethylene was separated and estimated, using gas chromatography.

Ethylene emanation was compared between unstressed excised leaves with or without water in the presence or absence of light for a period of 72 hr (Table 1). Signi-

TABLE 1: Effect of light on ethylene emanation from leaves of unstressed plants in the presence or absence of water. All values are in p mol. h⁻¹g⁻¹ FW \pm S. E. (standard error). Round figures only

Incubation Time (hr)	Treatments	Water ± S. E.		Without water ± S. E.	
		Light	Dark	Light	Dark
2		121 ± 10	71 ± 16	68 ± 3	27 ± 6
4		128 ± 14	90 ± 11	60 ± 7	28 ± 5
6		70 ± 8	55 ± 6	99 ± 12	19 ± 5
8		60 ± 4	45 ± 3	116 ± 16	14 ± 2
24		52 ± 6	21 ± 4	53 ± 8	18 ± 6
26		175 ± 14	125 ± 23	75 ± 17	46 ± 11
28		145 ± 9	138 ± 28	43 ± 4	64 ± 16
30		137 ± 12	113 ± 19	63 ± 2	48 ± 5
32		91 ± 7	86 ± 13	50 ± 2	37 ± 5
34			113 ± 15		37 ± 3
48		43 ± 8	64 ± 11	20 ± 3	21 ± 4
50		151 ± 12	119 ± 13	49 ± 6	54 ± 5
52		115 ± 9	151 ± 19	33 ± 3	51 ± 5
54		98 ± 20		44 ± 3	
56		74 ± 16	133 ± 10	62 ± 19	51 ± 4
72		25 ± 6	42 ± 7	27 ± 6	50 ± 10
Treatment mean		99.0 ± 10.3	91.1 ± 13.2	57.5 ± 7.4	37.7 ± 6.1
S. E.					

ificantly higher rates of ethylene emanation were recorded from excised leaves incubated with water compared to excised leaves incubated without water at first between 2-4 hr in the light and between 2-8 hr in the dark. In the light, second and third peaks were found at 26 hr and 50 hr respectively and in the dark at 28 hr and 52 hr in the excised leaves incubated with water. The leaves without water displayed higher rates of ethylene emanation in the light than in the dark, while leaves with water produced higher rates of ethylene only up to 4 hr from the start of the experiment in the light than in the dark. Light has been shown to increase the rate of ethylene production in oat seedlings⁴ and in lettuce seeds⁵. According to Bassi and Spencer⁶, light is necessary for increased ethylene emanation in response to high CO₂ treatment in intact sunflower plants. They also reported that prolonged exposure (about 16 hr) of plants to high CO₂ in the dark prevented the increase in ethylene emanation when the plants were exposed to light and high CO₂. However, stress-induced ethylene emanation in excised wheat leaves was reported to be inhibited by light⁷. Wright⁷ obtained up to 80% inhibition of ethylene emanation by light. He also recorded an inhibitory effect of light on ethylene emanation from unstressed wheat leaves but to a smaller degree.

The second and third peaks obtained in the excised leaves incubated with water were not prominent in the leaves incubated without water. These peaks of ethylene emanation were in some way related to the water status of the tissues but not to the light or dark incubation conditions. Perhaps an internal rhythm on ethylene emanation existed in the leaves which was not affected either by light or by dark and can operate only in the presence of free water. The role of leaf-water status in endogenous rhythms on ethylene production remains to be elucidated. When leaves were incubated without water,

the difference in ethylene emanation between light and dark treatments was found to be much higher, while in leaves incubated with water no difference in ethylene emanation was found. The reason is unclear and calls for further experimentation.

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Effect of temperature and light on seed germination of *Cuscuta chinensis*

Control of dodder (*Cuscuta chinensis* Lamk.) which is a menace of niger [*Guizotia abyssinica* Linn. f.] Cass.] may be possible by destroying the germinating power of its seed which serves¹ as the primary source of inoculum. However, knowledge on factors inducing optimum germination is essential prior to testing any of the promising chemicals which is, at present, inadequate. Therefore, the effect of temperature and light upon seed germination was studied in standard moist chambers. Each experiment, repeated for five times, consisted of four

replications of about 200 presoaked (24 hr) seeds per treatment and incubated at $29 \pm 1^\circ\text{C}$ for 21 days along with suitable checks. Germination counts were recorded at 3-day intervals and analysed statistically.

Optimum germination (Table 1) was obtained at 30°C and was *at par* with those

TABLE 1 : Percentage (angular values) of seed germination of *C. chinensis* incubated at different temperatures

Incubation temp. ($^\circ\text{C}$)	Incubation period (days)						
	3	6	9	12	15	18	21
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	13.8	22.3	24.8	27.7	28.9	30.3	31.5
25	18.2	23.3	26.0	28.7	31.1	33.0	34.8
30	20.7	28.5	32.1	34.0	36.5	33.2	39.9
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0

at 20 and 25°C . Germination at 30°C was faster than that at 20°C according to the Chi-square tests. No seed germinated at 10 and 40°C . *C. chinensis* was reported³ to germinate at $18-22^\circ\text{C}$ in 4-5 days. If it is true, the ecotype of this dodder prevailing in the tribal tracts of Orissa might have been acclimatised to a higher temperature than that was registered. Exposure to low temperature (Table 2) did not impair ger-

TABLE 2 : Percentage (angular values) of seed germination of *C. chinensis* exposed to 0, 50 and 60°C for different periods

Temperature ($^\circ\text{C}$)	period of treatment (hr)		
	6	12	24
0	25.0	26.9	25.6
50	29.3	26.9	3.3
60	31.0	5.6	0.0

Control = 25.6; C. D. at 5% = 10.2

mination significantly confirming the earlier reports^{2, 5}. Exposure to 60°C for 12 and 24 hr and to 50°C for 24 hr showed (Table 2) significant inhibition in germination. Treatments with hot water at 50, 55 and 60°C for 5, 10, 20 and 40 min also were ineffective in altering the amount and the rate of germination. Similarly, seeds ex-

posed to 0°C for 2 hr followed by 50°C for 2 hr and *vice versa* were ineffective too. In these experiments, however, some seeds tolerated high temperatures for short durations indicating that the thermotherapy might not serve as a feasible solution to dodder eradication.

Final germination counts (at 21 days) of seeds exposed to 0, 12 and 24 hr light per day were 47.70, 53.37 and 50.83 (angular values of %; C.D. at 5% = 4.21), respectively. Unlike earlier reports^{1, 6}, *C. chinensis* seemed to require 12 hr/day light for optimum germination. Exposure of seed to ultra-violet light (Table 3) for 5-20 min at a distance of

TABLE 3 : Percentage (angular values) of seed germination of *C. chinensis* exposed to ultra-violet light

Treatment distance (cm)	Duration of treatment (min)			
	5	10	20	40
30	36.03	36.80	42.88	26.78
60	47.41	33.40	36.81	24.43
90	36.09	36.63	35.43	21.56

Control = 19.28; C. D. at 5% = 12.17

30, 60 and 90 cm stimulated germination, whereas those exposed for 40 min proved inhibitory. Sensitivity of dodder seeds to UV light was not recorded earlier.

These studies revealed that optimum germination in *C. chinensis* occurred at 30°C and 12 hr/day light conditions. Some seeds tolerated high temperatures for short duration and UV light stimulated germination.

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**A new disease of pear caused by
*Pestalosphaeria elaeidis***

(Booth & Robertson) Van der Aa

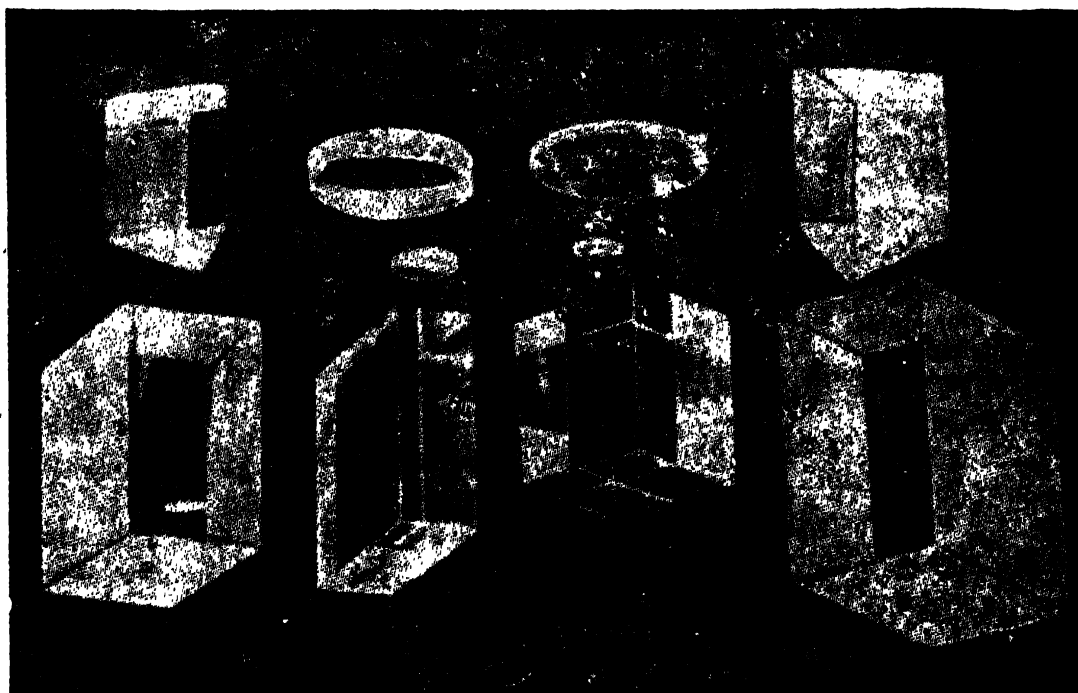
Pear (*Pyrus communis*) is one of the important fruit crops cultivated in Sikkim as well as in other parts of the country. During survey of plant diseases in Sikkim, a serious leaf spot/ blight disease was observed on *Pyrus communis* causing heavy defoliation in the affected trees. The disease was more severe during monsoon months.

The disease first appears as dark-brown, small pin-head size spots on dorsal surface of the leaves, which gradually increase in size. Older spots are round to elongate or irregular with ash coloured centre. The central portion of each spot is embedded with black dots. The number of spots per leaf varies from 1 to 6. In severe cases, several spots coalesce together to cause the blighting of the leaf lamina. The disease manifests predominantly at the time of new leaf emergence in April and May, when the temperature is $27^{\circ} \pm 2^{\circ}\text{C}$ along with high humidity and abundant rainfall.

The fungus was isolated in pure culture on Potato dextrose agar slants and its pathogenicity was established by artificial inoculation on healthy host leaves. The causal organism was identified as *Pestalosphaeria elaeidis* (Booth & Robertson) Van der Aa. This is known to be the perfect state of *Pestalotiopsis* sp and has not been earlier recorded on *Pyrus communis*. The type culture and specimen have been deposited in the herbarium of C.M.I., Kew, England under reference No. I.M.I. 252323. The authors are highly thankful to the Director, C.M.I., Kew, England for his help in identifying the fungus and the Director, I.C.A.R. Research Complex for N.E.H. Region for facilities.

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Received : 12 May, 1987.
Revised : 24 August, 1987.



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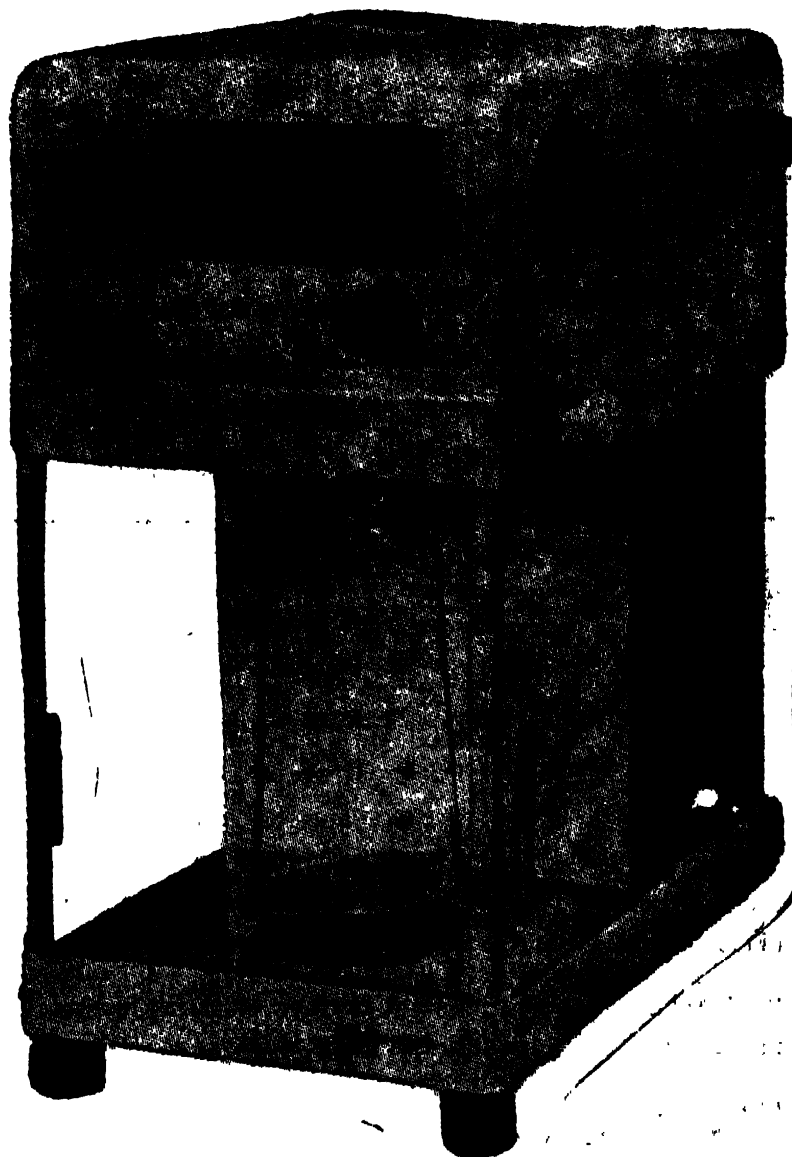
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